AFIT/GIR/LAR/93D-9

INFORMATION SHARING WITHIN THE COEA PROCESS

THESIS

Constance S. Maginnis, GS-13, USAF
Michael J. Monroe, Captain, USAF

AFIT/GIR/LAR/93D-9

The views expressed in this thesis are those of the authors and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

AFIT/GIR/LAR/93D-9

INFORMATION SHARING
WITHIN THE
COEA PROCESS

THESIS

Presented to the Faculty of the School of Logistics and

Acquisition Management

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Information Resource Management

Constance S. Maginnis, B.S.

GS-13, USAF

Michael J. Monroe, M.A.

Captain, USAF

December 1993

Acknowledgements

"Knowledge apart from application falls short of God's desire for His children. He wants us to apply what we learn so that we will change and grow" (Hough,1993: Foreword). Our main goal during the thesis process was to make a significant contribution to both academia and the real world. We feel we would not have accomplished this goal without the help of a few special people. We would like to thank our thesis advisors Captain Michael Shoukat and Major Michael Morabito for their time and effort. We would also like to express our appreciation to Mr. Richard Cronk, Mr. Alan Wallace, and Captain David McCormick. Without their expert support and encouragement, this effort might never have seen the light of day. Foremost, we would like to thank our families for giving so generously to our scholastic endeavors. Without their love, support and willingness, none of this would have been possible. Last, but never least, we would like to thank God for giving us a sense of humor which kept the darkness and gloom away during many a dark night.

Constance S. Maginnis

Michael J. Monroe

Table of Contents

List of Figures

List of Tables

AFIT/GIR/LAR/93D-9

Abstract

In order to meet the challenges of a reduced work force and the changing roles and/or missions of the Air Force in particular, it is imperative that all measures available be taken to effectively utilize current resources. Currently there is a Cost and Operational Effectiveness Analysis (COEA) used to assist in the decision-making of every phase of the acquisition process. The Office of the Assistant Secretary of Defense (OASD) has mandated that COEAs are to be an integral part of the acquisition process.

The COEA information gathering or sharing process is not well defined. Areas within the COEA process affected are the coordination of common elements of information required, the data collection, and the generation of possible solutions. The problem addressed by this research is how to improve the COEA information sharing process for data used to produce analyses for an organization. This improved process should result in a reduction of the time spent in continual meetings and conferences resolving conflicts within the process areas.

The result of our research indicates that the different processes within the COEA information process could be organized within a knowledge-based system (KBS) for improving the sharing of information and the overall efficiency of the process.

INFORMATION SHARING
WITHIN THE
COEA PROCESS

I. Introduction

General Issues

In the next several years, the Department of Defense (DoD) will be downsizing both personnel and material resources. The Commander of the Air Force Material Command (AFMC), General Ronald W. Yates, noted in a briefing before Congress,

> We were able to absorb the first round of cuts by such belt-tightening measures as cancelling vacant authorizations, placing surplus employees on other valid positions and attrition. Unfortunately, due to the magnitude of the future overstrength posture, AFMC could no longer resolve the problem for fiscal 1994 and beyond. Additional reductions, in excess of projected attrition, were projected for fiscal 1994-95. (1993:4)

In order to meet the challenges of a reduced work force and the changing roles and/or missions of the Air Force in particular, it is imperative that all measures available be taken to effectively utilize current resources.

Background

Subject matter experts expect, with the downsizing, the Air Force will be modifying more existing aircraft as opposed to designing and building new aircraft (Cronk,

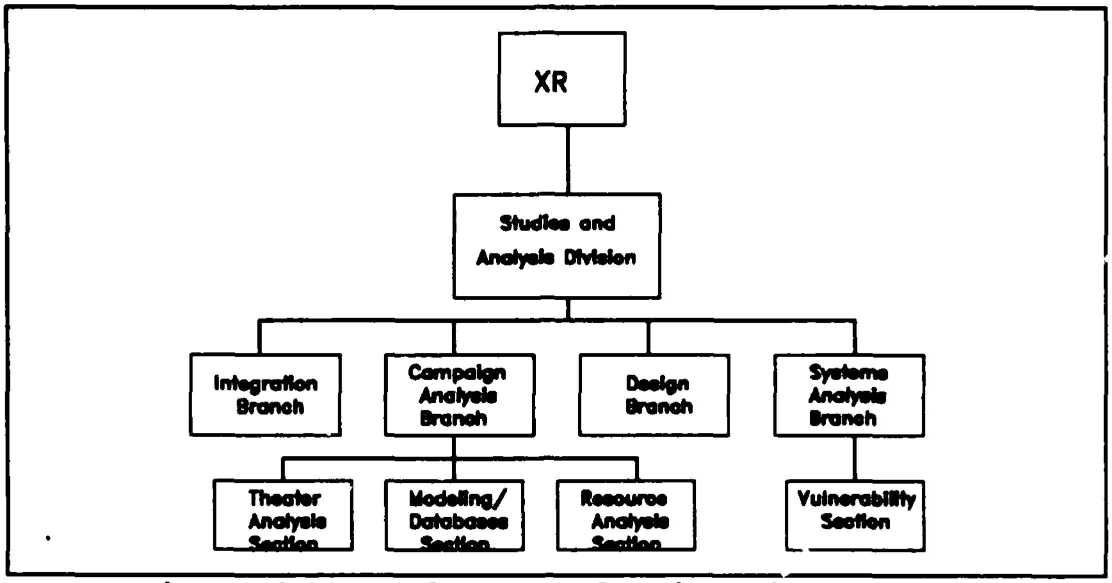

Figure 1. Development Planning Directorate

1993). To help meet the challenges of supporting these increased modifications, the Studies and Analyses Division (XRE) of the Aeronautical Systems Center (ASC) Directorate of Development Planning (XR) is tasked to produce one stop studies and analyses. Figure 1 shows the organizational structure for XR. "One stop" means the customer only interacts with one group to gain their desired information. XRE's primary customers are headquarters staffs within Air Force Material Command (AFMC), Air Force operations commands, Systems Programs Offices within ASC, and AFMC laboratories.

XRE's Campaign and Analysis Branch (XREC) provides feedback on a simulated series of military operations forming a distinct phase of a war (i.e. campaign). These simulated campaigns focus on the entire scope of land and air area that may become involved directly in military

engagements (i.e. theater-level). These simulations produce the perspectives necessary to evaluate modifications to existing systems and potential acquisitions of future systems. The Theater Analysis and Resource Analysis sections of XREC have the primary responsibility for two of the simulation models currently used to provide data for studies and analyses.

The Theater Analysis Section conducts theater-level campaign analysis through the use of the simulation model TAC THUNDER. TAC THUNDER is a two-sided theater-level war simulation program that models air and ground combat and logistics scenarios. The scenarios encompass such varied areas as force structure, terrain, and weapons systems as described by the user-supplied data. This simulation allows the analyst to study the effects of the changes in plans, tactics, force structures, and weapons systems at the theater-level.

Focusing on the general areas of supportability and affordability of the modification or acquisition proposed, the Resource Analysis Section quantifies the resources required to accomplish the various objectives for existing and future systems and subsystems. The Logistics Composite Model (LCOM) creates a representation of the work flow found in a maintenance organization and produces data that is then passed to the cost analysis section of XRE for identification of the optimal blend of resources to support a weapon system under peace-time and war-time operating

conditions. More recently, LCOM has been paired with comparability analysis techniques to produce a baseline configuration for new or modified systems. This comparative analysis feature was added to LCOM to anticipate the "problem" of the non-availability of in-house logistics support data for comparison. The analyst will then look at other sources for comparative data.

Whether a new or modified system is envisioned, each major command (MAJCOM) is responsible to produce a Cost and Operational Effectiveness Analysis (COEA). The COEA is required by the Office of the Assistant Secretary of Defense (OASD) to provide analytical rationale, facilitate discussion, and establish audit trails for milestone decisions regarding the acquisition of the new or modified system. Appendix G explains the five different types of COEAs that could possibly be required during the acquisition lifecycle. The results from each type of COEA are critical for selecting the best possible system to meet the customers requirements at that given phase. The Development Planning Directorate of the Aeronautical Systems Center (ASC/XR) is tasked with approximately 20 COEAs per year.

These COEAs are aircraft-based studies based on deficiencies, opportunities, or obsolescence issues as specified by the customer. COEA analyses require a tremendous amount of manual manipulation of data to produce the final reports and supporting documentation. For the

average COEA effort, XRE estimates each COEA will take at least 120 manhours.

With the downsizing of both personnel and material, the number of COEAs due to modifications will rise. This means that the various models utilized by the analysts in XRE to predict weapon system capabilities, survivability, and mission effectiveness will be used to an even greater extent. The standard operating procedures in place for all tasks require each group of analysts to enter individual input parameters to their simulation models. Mr. Richard Cronk, LCOM Group Leader, says one of the severest limiting factors within the XRE environment is no coordination among the various simulation groups during the development of the solution. At present there is no way of knowing whether each group has made its predictions using all the same criteria and assumptions.

Only after each model selected to contribute data to the COEA has been run is any coordination begun. This coordination is currently done manually during the integration of the selected model outputs. The coordination approach utilizes the stubby pencil method while trying to analyze what criteria and/or assumptions were used by each group through the time consuming method of conferences.

Mr. John M. Griffin, Director of ASC's Development Planning Directorate (ASC/XR), stated in his letter dated 23 December 1992 that the "new interest in COEA support and organic modeling and simulations capability demands that ASC

stays vibrant" (Griffin, 1992: 1). To remain "vibrant" in this era of downsizing means harnessing every potential manpower-saving tool within the Air Force's technological grasp.

Mr. Griffin further stated in the same letter that Studies and Analysis (XRE) "has been an ASC mainstay for years. I believe our XRE capability will definitely be needed as the Air Force faces a future of hard decisions driven by reduced resources" (Griffin, 1992:1). XRE currently is involved in at least 20 COEAs a year. The senior leadership within XR fully expects the number of COEAs to increase significantly, especially with a downsizing trend. Due to the economic realities that it is cheaper to modify existing airframes for new missions than to build new specific mission-based airframes as the Air Force and other services have done in the past, the number of COEAs will increase. Such an increase will strain (if not overload) the current capabilities within XRE to produce the foreseen number of COEAs. One answer is to produce tools that will expand the current capabilities without increasing the manpower base currently in place.

Specific Problem

The problem addressed by this research is how to improve the COEA information sharing process for data used to produce analyses for an organization.

Problem Statement

Within Aeronautical Systems Center's Studies and Analysis Division (ASC/XRE), the Campaign Analysis Branch (XREC) is a process-based organization that flows each product except the Cost and Operational Effectiveness Analysis (COEA) through a standardized process. The COEA is a product that has been mandated by the Office of the Assistant Secretary of Defense (OASD) as an essential part of the weapons systems acquisition process. An information system to perform the information sharing necessary for each COEA needs to be developed. By definition, an information system is "an open purposive system that produces information using the input/process/output cycle. The minimal information system consists of people, procedures, and data" (Kroenke, 1992:782).

Objectives

The objectives for organizing the COEA process within an information system framework which will prove the concept of information sharing are as follows:

1. Identify the information that is commonly used by the two models.
2. Develop the specific form the information will be in when passed to the two models.
3. Identify the assumptions made by each model as to the meaning of the information and how it will be used in the model.

4. Identify the various integrated scenarios that could derive the needed data.

5. Develop a prototype information system.

Limitations on the Scope of the Research

Since the objective of the research is to prove the concept of information sharing through an information system, the main limitation is the selection of appropriate information and scenarios that will be a representative sample of the overall problem. The simulation models selected for this study are integral in almost every COEA. Another limitation is how closely the structured and unstructured knowledge of the experts can be modeled in the COEA information sharing system that will function as the overall data information source. A third limiting factor is the inherent limitation of all expert-system-building tools, their inability to directly interact with the domain expert, thus limiting their ability to acquire knowledge.

Justification of the Research

The justification for the desired capability of sharing the information to be used by each of these models is two-fold. First, there is the need to support the Integrated Product Development program within ASC. There is a current initiative within ASC from the commander that states all projects will comply with an integrated product development cycle.

> I see this operational initiation as the culmination of the management direction coming out of the commander's off-sites to effect a world class development planning capability. XR's role in the commander's vision is to provide a highly professional study and analysis function including strong emphasis on the customer interface through planning and roadmapping, an aggressive search for opportunities to exploit new concepts for making quantum improvements in Air Force war fighting capability, and providing investment strategy guidance to the laboratories for support and timely transition of their science and technology programs. (Boyd, 1992)

Last, in support of the continuing downsizing of DoD, ASC/XR proposed a reduction of 30 per cent of the combined manpower within ASC/XR. To support this reduction, improving the current processes through the use of a standardized information source will help reduce the effect of this projected cutback.

Summary

The downsizing of DoD is forcing several initiatives to take place to enable better utilization of the remaining personnel and material resources. Automating procedures which are currently done manually is one such way that better utilization can be accomplished. The sharing of common information to be used as guidance for producing the parameters for use within the models in an automated manner is one such example where manpower can be better utilized.

Definition of Terms

Terms used throughout the thesis are defined in Appendix A.

Overview

Chapter 2 contains a review of the literature of successful applications of information sharing as a solution. Chapter 3 provides the methodology of the development of an information system solution for the successful sharing of information to be used as guidance for parameter generation for LCOM and TAC THUNDER. The results of applying the methodology outlined in Chapter 3 will be the focus of Chapter 4. The conclusions of the study and recommendations for any further study or action to be taken by XRE will be found in Chapter 5.

II. Literature Review

Introduction

The purpose of this chapter would normally be to review the literature which discussed actual solutions other organizations (companies, etc.) have implemented in similar situations. Part of the problem with finding any relevant information is wading through the hyperbole and getting down to the cold, hard, facts of what exactly is data sharing. Data sharing occurs "when two general conditions are satisfied: (1) they (data) are used by organizational members and (2) they can be linked to organizational effectiveness" (*Wyse and Higgins*, 1993:34).

Review Findings

The researchers conducted extensive searches through the Air Force Institute of Technology (AFIT) Library, the Defense Technical Information Center (DTIC), the Dialog Service electronic library and the National Aeronautics and Space Administration (NASA) research library. Although the searches produced several hundred citations, the majority of the citations were not relevant to the research effort. The keywords used in each of the searches were: data sharing, data integration, data management, database management, relational database management system, data simulation,

information transfer, technology transfer, information flow, and information management.

The only citations that appeared relevant to the research effort dealt with integration or sharing of the data shared by two or more databases (Kamel and Zviran, 1991) (Walker, 1990). After further research along this line in LCOM and TAC THUNDER, the researchers determined with Mr. Cronk's and Captain McCormick's help that the information to be shared was not of the form to be stored and retrieved from a database format.

There are references to the theory of the use of knowledge-based systems to solve the problems of sharing information. These references were found within trade journals, textbooks, and popular literature. But no actual applications were mentioned in any of the references.

It is the researcher's speculation that the lack of published examples of successful applications is due in part to the competitiveness of business. In informal discussions with a senior systems engineer at a leading-edge information technology business, he supported the researchers' conclusions by stating information sharing to this degree would be the competitive edge.

It is still the researcher's contention that using knowledge-based systems is another avenue for the sharing of information. Such an application has great potential to increase an organization's effectiveness and efficiency through interoperability.

Summary

The researchers, after reviewing several hundred citations, found no documented successful applications of an information system that handled the same type of information as needed by LCOM and TAC THUNDER. Therefore the research is the first to be documented in the area of using a knowledge-based information system to share information.

III. Methodology

Overview

This chapter will provide a discussion of the methodology to be used in this thesis. The basic form of the methodology being utilized is documented by Mockler and Dologite in their 1992 book Knowledge-Based Systems, An Introduction to Expert Systems. The chapter will culminate with a table that summarizes the steps necessary to build a knowledge-based system.

Justification of the use of a Knowledge Based System

With the current trend of downsizing, human expertise will become even more scarce and needed in a variety of locations and projects. A tool is required that will allow anyone with a working knowledge of the COEA process to begin gathering information without immediate access to the human experts.

The needs of XREC fall under the planning category for knowledge based systems (KBSs) as found in the Mockler and Dologite text on p. 17. The KBS that XREC needs would play an integral part in the military planning of how to wisely spend the ever-shrinking defense dollars the Department of Defense has been appropriated.

The benefits for applying a KBS to this process are as follows:

> The KBS provides for a consistent level of service to be delivered, regardless of who is on duty.
>
> The KBS makes possible decision-making by personnel who were previously unauthorized to make decisions.
>
> The KBS ensures that decisions are always made using the same set of criteria. When the COEA is then integrated, this KBS tool will help in resolving any conflicting findings between the simulation models.
>
> The KBS can be used to train personnel, which frees more experienced staff for other duties.
>
> The KBS can be replicated and used wherever COEAs are processed, assuring the organization of a consistent level of service.
>
> The KBS can easily be changed to reflect new or revised process regulations and then be quickly replicated and distributed to implement the change uniformly throughout the organization without incurring personnel retraining expenses. (Mockler and Dologite:102-103)

Common Pitfalls Within Expert Systems

Waterman (1986:186-199) uses three chapters in his book to discuss in depth a variety of pitfalls every developer might encounter within the areas of expert system planning and development. The areas listed below are the more common ones to look for major pitfalls within any expert system development effort. Beside each listed pitfall are the steps the researchers took to avoid each area that applied to their development effort.

1. Choosing an Appropriate Problem. This problem was dealt with by a series of interactive assignments within the Artificial Intelligence class taught by Captain Michael Shoukat. By turning in a topic outline, a specific problem statement, and a midterm project (that included all the KBS development steps except entering the KBS into the computer), the researchers ensured the problem was not only appropriate but properly scoped in size.

2. Choosing the Expert System Building Tool. The researchers chose EXSYS Professional since this tool's capabilities matched the problem domain characteristics as found in the initial knowledge acquisition.

3. Choosing the Domain Expert. This was not a problem for the researchers since both LCOM and TAC THUNDER provided the best experts available.

4. Interacting with the Domain Expert. This problem was averted by having dealt with these experts for months during the initial thesis research and problem definition.

5. System Implementation. Most of the pitfalls within this area were handled by testing the rules as they were developed through a series of interviews. Any other problems were eliminated by using EXSYS Professional and many of its validation and inference-checking capabilities.

6. System Testing and Evaluation. The pitfalls usually associated with this area were avoided by using the appropriate planning techniques as specified by Captain Shoukat. Other design flaws that could appear during this stage of KBS development were handled through the use of ergonomic development techniques as outlined in Human Factors in Engineering and Design by Sanders and McCormick.

Development of Knowledge-Based System

After careful review of the steps for the development of a KBS as found in several sources (Hayes-Roth, 1983:139) (Waterman, 1986:137) (Mockler and Dologite, 1992:46) (Irwin, 1991:3-1) (Nelson, 1991:41), the researchers have concluded that KBS development can be broken down into five phases: Project Planning, Analysis, Transformation, Implementation, and Testing. Figure 2 demonstrates the recursive nature of the five phases.

A. Project Planning Phase

The purpose of the Project Planning Phase is to determine the area of study, properly scope the area of study, and to determine whether or not to proceed with the project. This process studies the business need, the feasibility of the project, and the cost/benefit comparison of the KBS. In the pursuit of the answers to these steps, the developer is involved in the initial knowledge

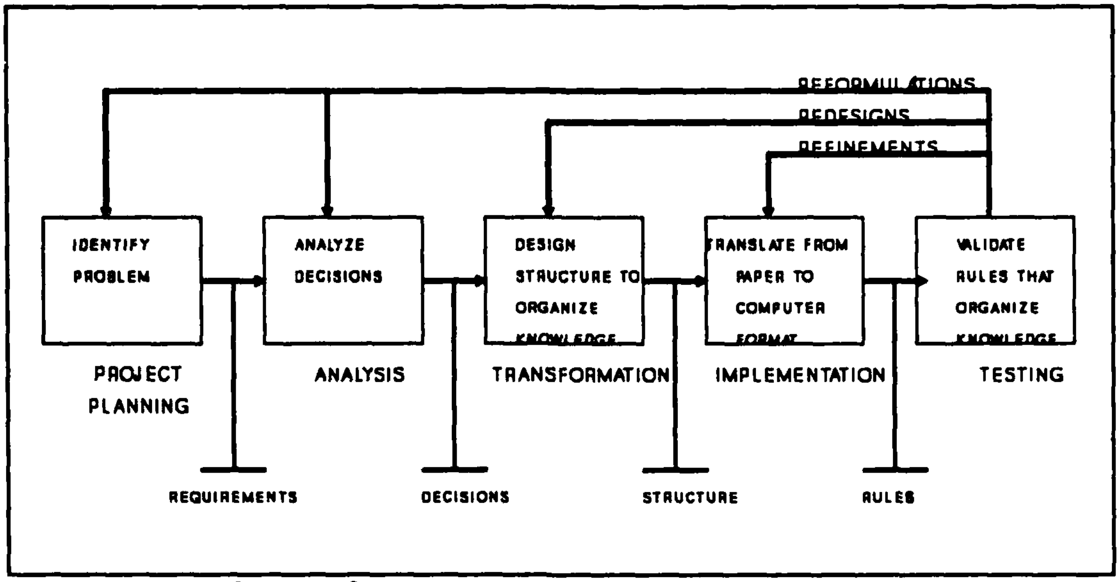

Figure 2. Phases of KBS Development

acquisition of the project. The culminating product of this phase is to determine the level of risk for the initial prototype.

1. Selection of the Project.

One of the many reasons for building a knowledge-based expert system is that the human expertise of both Mr. Richard Cronk, Group Leader of the Logistics Composite Model (LCOM), and Captain Dave McCormick, Operations Research Analyst for TAC THUNDER, is needed in a variety of locations. At present, neither of these group leaders are located in the same building which makes interaction on many projects difficult at best. Since the Office of the Assistant Secretary of Defense (OASD) requires Cost and Operational Effectiveness Analyses (COEAs) for the acquisition of many DoD acquisition categories, the COEA has become an "essential" part of the acquisition process.

According to AFSC Pamphlet (AFSCP) 173-1, "COEAs are comparative analyses of the costs and operational effectiveness of alternative solutions intended to satisfy an established mission need" (p. 2). Out of the six COEAs currently underway, LCOM is involved in some way in all six while TAC THUNDER is involved in five out of the six.

2. Definition

The prototype KBS will integrate data from several of the necessary fields within a specified LCOM scenario. In order to help answer a number of the areas of concern within the COEA, an analysis will be performed to select the appropriate data from among the various fields of possible data. Sources for this analysis will include written guidelines for the COEA process and interviews with Mr Cronk that will identify the decisions to be modeled and determine which specific areas always have an overall importance to the final COEA answer.

3. Preliminary Screening

According to Mockler and Dologite (1992:47-48), several questions need to be answered as part of the preliminary screening process. The purpose of these questions is to determine the feasibility and appropriateness of the area under study. These include:

a. Do recognized experts exist?

b. Can the experts do the task better than amateurs and can their skills be taught to others?

c. Do different experts agree on the solutions?

d. Does the task require reason and informed judgments, as opposed to mere common sense?

e. Is the task well understood?

f. Can the experts articulate their methods?

g. Is the task of manageable size?

h. Are typical example cases or situations readily available?

The specific answers to the above questions are found in Chapter 4.

4. Estimating the level of risk

Several areas of concern that need to be addressed when determining the level of risk are found within Mockler and Dologite (1992:53).

a. Knowledge Area Complexity can be Simple, Moderate, or Complex.

b. Knowledge Area Expertise Availability can be Favorable, Neutral, or Unfavorable.

c. Organizational Units Involved can be any number.

d. Company Management Involved can be Favorable, Neutral, or Unfavorable.

e. Organizational Environment Complexity can be Favorable, Neutral, or Unfavorable.

f. Computer Expertise Requirements can be Favorable, Neutral, or Unfavorable.

g. Computer Expertise and Availability can be Favorable, Neutral, or Unfavorable.

h. Computer Expertise Adequacy can be Good, Okay, or Poor.

B. Analysis Phase The analysis phase requires decomposing the decision situation under study into the smallest manageable pieces possible. The information from this decomposition process will be documented in block diagrams known as decision situation diagrams (which model the specific area under study).

1. Intermediary Knowledge Acquisition

> The goal of knowledge acquisition and representation is the transfer and transformation of problem-solving and decision-making expertise from some knowledge source into a form useful for developing a knowledge-based system. (Mockler and Dologite, 1992:237)

The next area to address is which strategy for general knowledge acquisition is best for the problem at hand. There are two overall strategies for knowledge acquisition according to Mockler and Dologite. These strategies differ in the areas of the basic nature of the interaction and the timeframe allowed for the knowledge acquisition.

There are three types of interactions possible between a knowledge engineer and his knowledge source: interaction between the knowledge engineer and a domain expert; interaction between the knowledge engineer and written or other knowledge sources; or interaction between a machine and the knowledge sources. Knowledge acquisition, for the KBS prototype will be gained through a series of interviews with domain experts from both the LCOM and TAC THUNDER systems within ASC/XRE.

An important question to be asked during these interviews are how the domain expert uses a given strategy to solve a certain problem. These interviews will cover the two types of knowledge--structured and unstructured. Structured knowledge is that which is gained through the formal education process or reading books. Unstructured knowledge (also known as heuristics) is gained from on-the-job experiences the expert has had or has been passed on by others.

For the research at hand, the unstructured interview method was selected based upon the following:

> An unstructured interview is used to start many knowledge acquisition tasks, since it can be effective in exploring the background knowledge involved in a situation. During an unstructured interview, a knowledge engineer actively questions the expert, for example, by asking spontaneous questions as the expert is performing a task. (Mockler and Dologite, 1992:238)

For the unstructured interview, the researchers came up with a number of general questions covering the process of solving a COEA. The questions are as follows:

a. What rules/regulations/procedures (formal and informal) are used every time that require information to be answered?

b. What kinds of data or knowledge is needed to reach the decisions required by the COEA?

c. Describe a typical problem for each decision?

d. What are the critical factors or conditions that need to be met? (i.e. type of aircraft used in COEA).

e. Steps that occur when you receive a COEA?

2. Decision Situation Diagrams

As the area under study is further analyzed and evaluated, the original decision situation diagrams are refined to get a more precise picture of how the decision or task under study is accomplished.

C. Transformation Phase This phase is where the decision situations diagrams are "transformed" into dependency diagrams (which indicate the interrelationships among critical factors, input questions, rules, values, and recommendations made by the KBS prototype) and decision tables (which are the final major step within the modeling analysis). From this paper model, the actual code for the KBS will be written.

D. Implementation Phase In this phase the developer translates the paper models of the IF-THEN Rules and the user interface screens into a computer-based knowledge base format. This translation is accomplished using an approach known as operational prototyping.

According to Turban, "Prototyping refers to a process of building a 'quick and dirty' version of information systems" (Turban, 1990:195). Operational prototyping combines the rapid results of the throwaway prototype approach with the stability offered by the evolutionary prototype approach. An evolutionary prototype is built during the translation, implementing only the specifications that are well understood.

Once this translation is complete, the developer runs trial consultations to produce a debugged baseline knowledge base. During these trial consultations the prototyper also validates the inference rules of the knowledge base. These rules should depict the correct premises of the applications as they were described to the prototyper during the interviews with the domain expert.

E. Testing Next, this baseline is used by the prototyper in a validation test. In order to conduct the validation test both the prototype and the expert will be given a set of test cases to solve. The solutions from both the prototype and the expert will be compared. Whenever a discrepancy is discovered between the results, the discrepancy will be resolved and the test case reran.

Summary

The successful building of this information system will prove the concept that data can indeed be shared within the COEA process in XRE. This KBS prototype will then be the key for XRE to go into a full scale development of an evolutionary prototype information system. This prototype will be the vehicle to share the information with the other simulation models. By following the operational prototyping approach, the research prototype information system will become the throwaway used to validate the concept of sharing information.

TABLE 1

STEPS TO KBS DEVELOPMENT

Step	Phase	Tangible Products
Isolate Area for KBS Development	Project Planning	Block Diagram of Area Under Study
Target a Decision to be Prototyped	Analysis	Decision Situation Diagrams with Critical Factors
Create Decision Tables	Transformation	Decision Tables
Create Dependency Diagrams	Transformation	Dependency Diagrams
Write IF-THEN Rules	Transformation	IF-THEN Rules (Paper Model)
Design User Interface	Transformation	Paper Model of User Interaction Screens
Enter Knowledge Base into computer	Implementation	Computer Based Knowledge Base
Run Trial Consultation	Implementation	Debugged Baseline Knowledge Base
Test and Validate	Testing	The Prototype KBS

(Hayes-Roth, 1983:139) (Waterman, 1986:137)
(Mockler and Dologite, 1992:104)

IV. Results

Overview

In this chapter the researchers will present the results and findings from their use of the methodology described in Chapter 3. Each of the areas from Chapter 3 are discussed below .

Results of Applying Methodology

The results of each of the objectives mentioned in Chapter 1 will be demonstrated within this section of the chapter.

Objective 1. Identify the information that is commonly used by the two models.

The information that is common to both of the models was identified through a structured interview with both Mr. Cronk and Captain McCormick. The results of the interview process can be found in Appendix G, III. COEA Gatherer.

Objective 2. Develop the specific form the information will be in when passed to the two models.

The specific form was developed and prototyped within each KBS prototype. The final form for this information will be determined by the developers from ASC when they build the full-scale KBS.

Objective 3. Identify the assumptions made by each model as to the meaning of the information and how it will be used in the model.

The assumptions for each common area are the various possible answers for each of the questions used in the COEA Gatherer. Please refer to Appendix G, III. COEA Gatherer for these possible answers. Each model uses the information gathered to produce their specific portion of the COEA.

Objective 4. Identify the various integrated scenarios that could derive the needed data.

The nature of the COEA process is to analyze any potential acquisition or modification to a weapon system, based upon the proposed scenario. Experts like Mr. Cronk and Captain McCormick ensure the proposed scenarios "fit" before applying their specific simulation model to produce the COEA results. Therefore, any scenario proposed by the user/sponsor of the COEA will "fit" this objective.

Objective 5. Develop a prototype information system.

In Table 1 of Chapter 3, the nine steps of the KBS Development Process Steps are listed. As Mockler and Dologite noted in their book, "the design methodology can be applied to whatever shell is used" (1992:103). The steps are as follows:

A. Isolate the Area for KBS Development.

Create a block diagram of the area under study. It should indicate the sub-area selected for the initial KBS

prototype development. This block diagram is found in Chapter 1 as Figure 1.

B. Target a Decision to be Prototyped.

Create a block diagram of the exact decision situations to be prototyped. Through the use of the prototyping methodology, the researchers discovered a need for a third area within the COEA process. Therefore, there are three specific situations to be prototyped. The three situations are LCOM, TAC THUNDER, and the COEA Gatherer. Each block diagram should indicate the critical factors necessary to make a recommendation. These block diagrams are found as Figures 3 through 7.

C. Create Decision Tables.

These decision tables should indicate all input questions, rules, values, and recommendations made by the

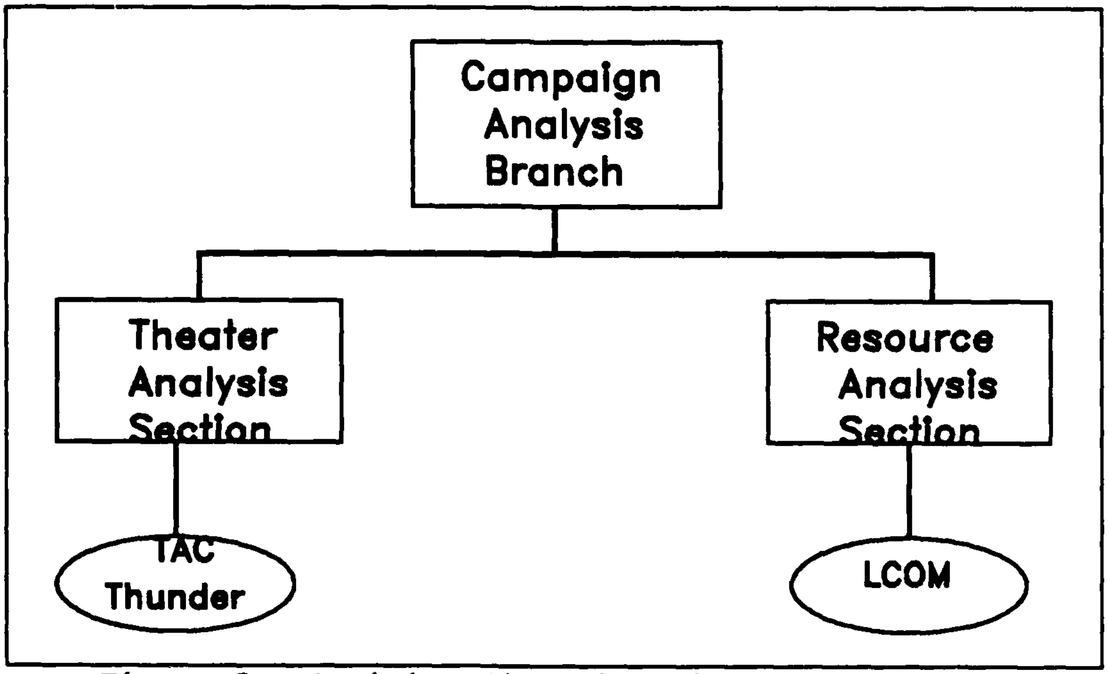

Figure 3. Decision Situation Diagram (Level 1)

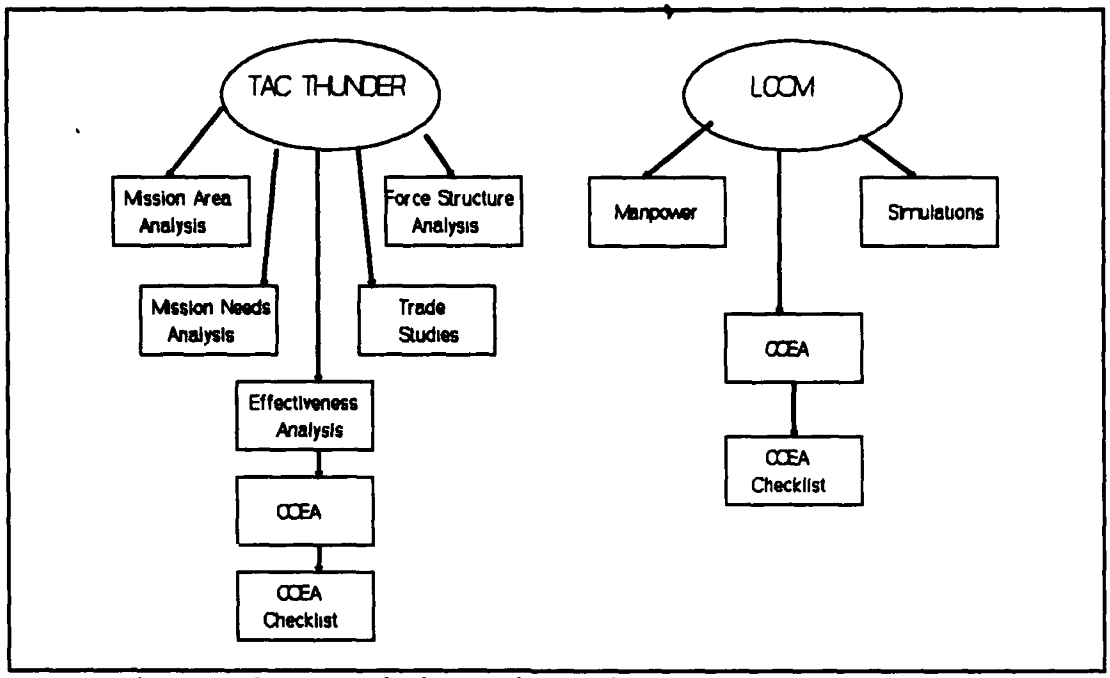

Figure 4. Decision Situation Diagram (Level 2)

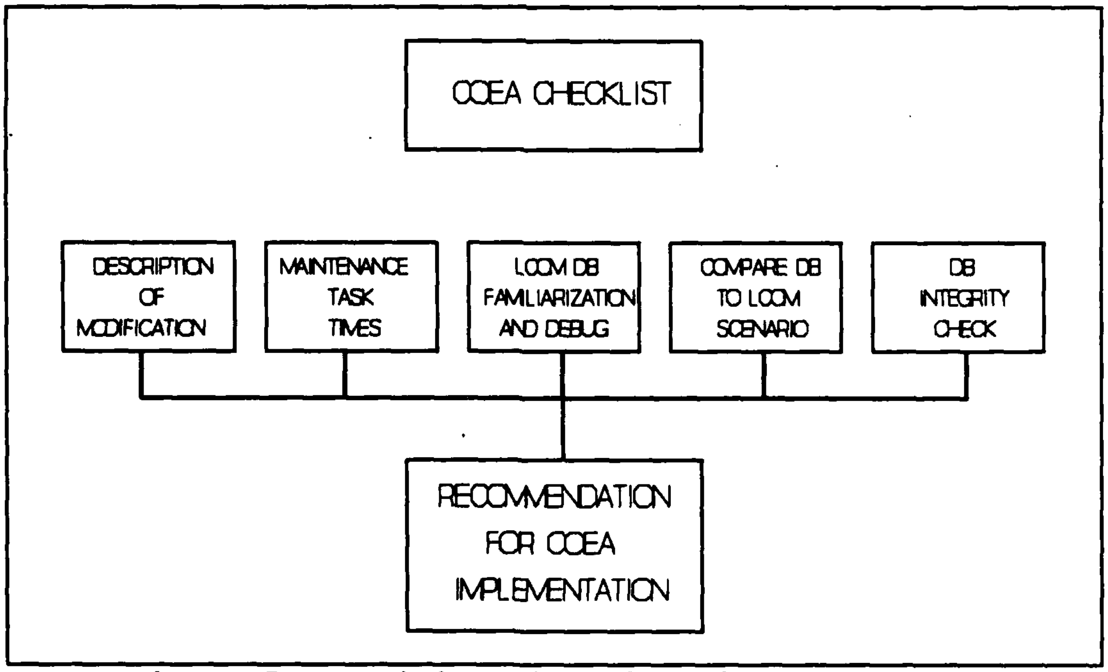

Figure 5. Decision Situation Diagram -- LCOM

KBS prototypes. The decision tables for LCOM, TAC THUNDER, and COEA Gatherer are found in Appendix C.

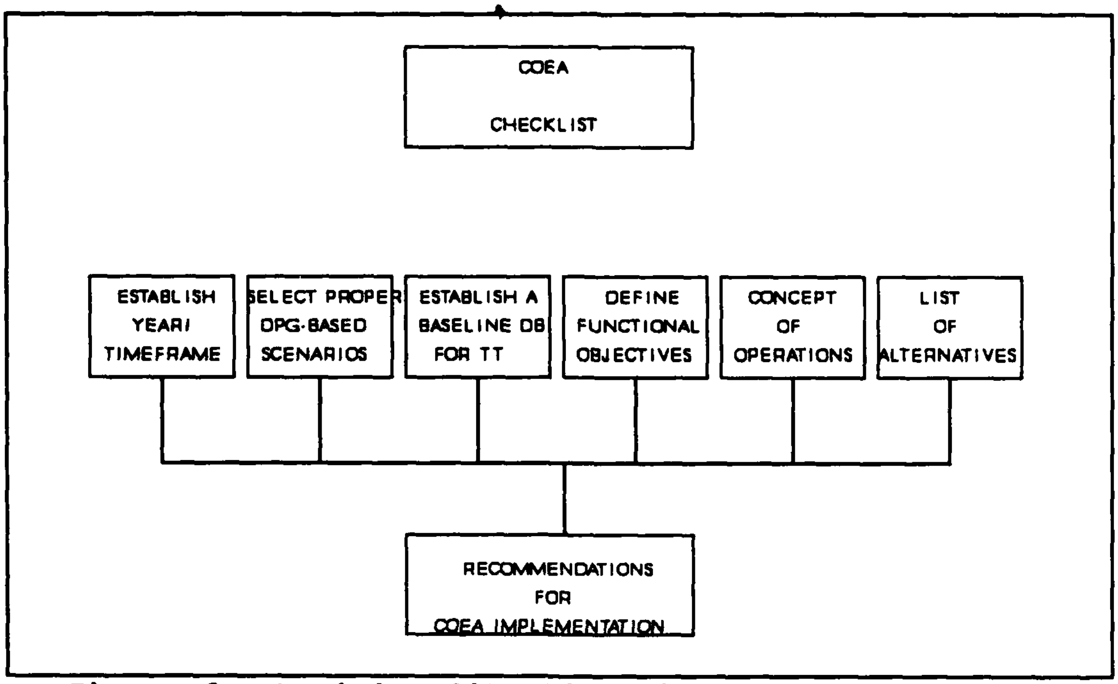

Figure 6. Decision Situation Diagram -- TAC THUNDER

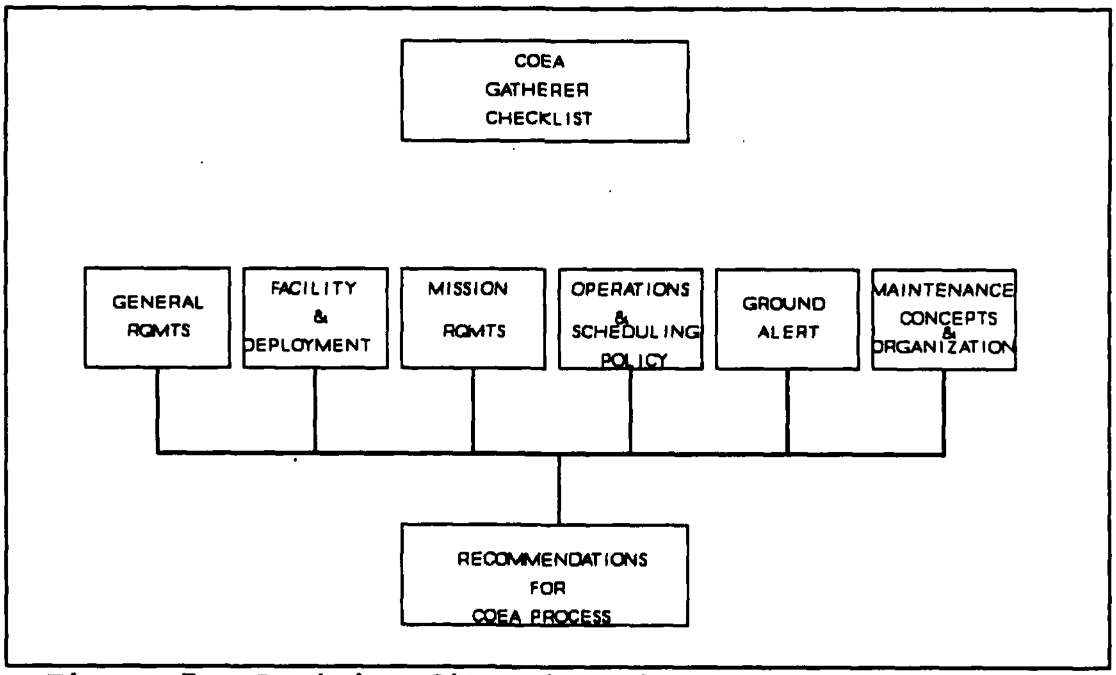

Figure 7. Decision Situation Diagram -- COEA Gatherer

D. Create a Dependency Diagram.

Convert the final block diagram from Step B into a dependency diagram. Each triangle represents a decision

table from the earlier steps. These dependency diagrams are found as Appendix D.

E. Write IF-THEN Rules.

Convert the reduced decision tables to IF-THEN rules. The IF-THEN rules for the KBS are found in Appendix E.

F. Construct the User Interface.

These segments are the parts a user sees when running a consultation. These screens usually consists of the opening and closing messages for the consulting session. EXSYS Professional does not currently have the capability of the "Print Screen" to allow the printing of each individual consultation screen. The user interface messages (Opening and Closing) however can be found in Appendix F.

G. Enter the Knowledge Base into the Computer.

Using the expert system shell "editor", type the elements that constitute the "knowledge base" into the computer file. This knowledge base is found in Appendix G.

H. Run a Trial Consultation.

If errors prevent a smooth run, the developer will "debug" the errors using the editor. This "debugging" process often takes several iterations to rid the file of all latent "bugs". With EXSYS Professional, rather than manually debugging the KBS, the developer can validate the KBS. These validations can be accomplished by using either systematic or random testing method.

> Systematic testing allows all possible combinations of input to be tested for a variety of possible errors. If the expert system is large, and systematic testing the entire system would take too long, systematic testing of portions of the system or random testing of the entire system can be performed. (EXSYS Manual: C102)

There are three different validation files that are created everytime the KBS is run through the validation option. The first is the branched tree diagram, which conveniently displays the overall KBS structure for each choice selected.

The second type of tree diagram is the linear, which displays all the values from each node for a specific branch displayed in the first validation diagram. The third validation is the error file, which contains any reports of detected errors and the input that produced the error.

> The validation function will detect and report combinations of input that:
>
> 1. Produced no conclusions
>
> 2. Failed to derive needed qualifiers or variables that should be derived
>
> 3. Created error loops
>
> 4. Assigned a variable a value which is outside of the limits specified for the variable
>
> 5. Assigned more values to a qualifier than the maximum number allowed for that qualifier
>
> 6. Special custom tests designed with the report generator. (EXSYS Manual: C104)

I. Test and Validate the Prototype.

Test case scenarios that were used to test and validate the prototypes were an on-going real-world COEA project. Using the KC-135 Multi-Point Refueling COEA as the test case, the sponsors responded to questions posed by the COEA Gatherer KBS prototype. The results were automatically saved to a file. The final results, which match exactly the conclusions drawn by the experts, are available in Appendix I. Both Mr. Cronk and Captain McCormick agreed that these KBSs will be valuable tools when fully developed.

Preliminary Screening In the area of Preliminary Screening, Mockler and Dologite (1992:47-48) stated several questions need to be answered as part of the preliminary screening process.

1. Do recognized experts exist? The Department of the Air Force has entrusted both Mr. Cronk and Captain McCormick with the management and leadership of each of the two simulation models, LCOM and TAC THUNDER. If anyone within ASC has any questions about these systems, these are the people they turn to for the answers.

2. Can the experts do the task better than amateurs and can their skills be taught to others? The experts have developed the answers for each COEA and need to have this information codified and replicated within a knowledge based system (KBS) to further integrate their ability to analyze and answer questions much more efficiently.

3. Do different experts agree on solutions? An important element of COEAs is that since they "often involve very different systems advocated by different services or commands, this process provides a disciplined approach for comparing concepts" (AFSCP 173-1:1). This process makes the different experts "agree" as well as experts with differing opinions are able to reach a consensus of opinion.

4. Does the task require reason and informed judgments, as opposed to mere common sense? Yes, the task at hand requires "information and supporting documentation from the COEA process (that) is critical for selecting the best possible system to satisfy user requirements" (AFSCP 173-1:2). Such a requirement cannot be derived from common sensical approaches to any COEA.

5. Is the task well understood? Besides the AFSC pamphlet for guidance, COEAs have been accomplished since late 1989. Both Mr. Cronk and Captain McCormick can provide additional information about all aspects of the COEA from their functional area. As ASC/XREC members, both have been around the COEA process since its inception.

6. Can the experts articulate their methods? The experts have been forced to articulate their methods through such avenues as DoD Directives 5000.1 and .2, the AFSC pamphlet, and the former Strategic Air Command's COEA implementation plan. There have been more data gained through several interviews and suggested readings on LCOM, TAC THUNDER, and COEAs.

7. Is the task of manageable size? The task will be scoped to a manageable size to allow the prototype to be built.

8. Are typical example cases or situations readily available? The COEA process has been well defined and, as previously mentioned, there are 6 COEAs currently ongoing at this point in time.

In area A 4, the Decision Situation Diagram for Estimating KBS Project Proposal Level of Risk (Initial Prototype Phase), the following answers were developed through the knowledge acquisition and interview processes used by the researchers.

a. Knowledge Area Complexity is Complex
b. Knowledge Area Expertise Availability is Favorable
c. Organizational Units Involved = 2
d. Company Management Involved = Favorable
e. Organizational Environment Complexity is Favorable
f. Computer Expertise Requirements is Favorable
g. Computer Expertise and Availability is Favorable
h. Computer Expertise Adequacy is Good

The determined level of risk for the development of the initial prototype phase is Favorable.

Limitations of the Results

During the process of applying the prototyping methodology, the researchers discovered the problem at the foundation of the COEA process. Although the KBSs developed will improve the information sharing within the COEA process, a redefining of the overall process is essential before all the potential benefits can be realized. The original problem scope stated that it was a lack of information sharing within the COEA process.

During the unstructured interviews with both experts present it was discovered that the process is not well defined. This lack of proper process definition has led to disconnects in the effectiveness and efficiency of the dissemination of information necessary to the COEA process. This discovery is outside the scope of the initial research effort.

Summary

An overall review of the results shows that the use of the KBSs as the solution to the problem of information sharing is appropriate. When the process has been redefined and the KBSs fully implemented within the process, the benefits of the solution will be fully realized.

V. Conclusions and Recommendations

Introduction

This chapter draws conclusions from the results presented in Chapter IV. Based upon these results, recommendations are made and then areas for further research are described.

Conclusions

Discovering the lack of process definition within the COEA process while understanding the potential for the COEA process indicates the critical need for process improvement. The biggest flaw within the current process flow is the lack of coordination which is manifested in the continual meetings and conferences to resolve conflicts within the process areas. The areas affected by this lack are the initial scoping of the COEA solution process, the model-specific data collection, and the generation and integration of the model results into the final COEA analysis report. This same lack of coordination makes the process inefficient by not properly using all the assets available to the process.

In the manpower realm alone there are demonstrable inefficiencies within the current COEA process. People are misused in two ways. First, the people requested to attend the continual meetings, and conferences may receive only a few minutes worth of pertinent information, thereby wasting

the rest of their time at the meeting. Second, people are not requested to attend meetings when they should be included. This means these individuals miss a chance to receive the needed information first-hand and then to avail themselves of the opportunities to request other needed information at the appropriate moment.

Another realm where inefficiency currently exists is the waste of available information. Since no formal or informal "information networks" exist within the COEA process, needed information and cross-functional expertise are not used. Only after the experts from LCOM and TAC THUNDER met for the discussion and unstructured interviews for the KBSs, did the realization of the potential benefits of networking their common information become evident. This artificial communications barrier is a holdover from the days before XR was integrated to better support the Integrated Product Development concept. Business reorganization alone is never enough to improve the processes found within an organization.

Recommendations

The first recommendation is to redefine the process using a functional process improvement methodology. In 1992, the Director of Defense Information for OASD issued the *Interim Management Guidance on Functional Process Improvement (DoD 8020.1-M)*. This guidance provides "DoD functional managers with the processes and procedures that

should be applied when conducting process improvement projects throughout the DoD" (CIM, 1993:v). Without this process improvement, no tool or organizational framework can be successfully implemented.

Only after the process has been redefined and restructured should any tools be selected or built to support the process. Once the process has been redefined and well understood, the environment will be able to reap all the potential benefits of the researcher's proposed solution. The process redefinition will help in fully defining those specific areas where a KBS can be utilized to enhance the information gathering process necessary for the COEA.

Further Research

Areas for further research from the concept of information sharing are enormous. Theses could be developed from the following: developing the full-scale versions of all three of the KBSs prototyped within this study, using a functional improvement methodology to redefine and restructure the COEA process as found here at WPAFB, and integrating and/or standardizing the COEA processes between each separate Air Force activity that uses the COEA process.

All of these suggested theses have the potential to help shape tomorrow's Air Force in a significant way. Each thesis idea could certainly be a sponsored effort, ensuring the proper level of support necessary to produce a quality thesis.

Appendix A: Definitions of Terms

Application. A computer program that provides features and functions particular to the user's information needs (Kroenke, 1992:777).

Artificial Intelligence. The capability of a device, such as a computer, to perform functions or tasks that would be regarded as intelligent, if they were observed in humans (Mockler and Dologite, 1992:772).

Domain Expert. An individual who is highly recognized as having the knowledge and know-how necessary to solve a problem or make a decision in a specific knowledge domain (Mockler and Dologite, 1992:773).

Effectiveness. The attainment of a predetermined goal. The degree to which a predetermined goal is met (Horngren and Foster, 1991:943).

Efficiency. The relationship between the inputs used and outputs achieved. The fewer the inputs used to attain a given output, the greater the efficiency (Horngren and Foster, 1991:943).

Ergonomics (Also known as Human Factors). Discovers and applies information about human behavior, abilities, limitations, and other characteristics to the design of tools, machines, systems, tasks, jobs, and environments for productive, safe, comfortable, and effective human use (Sanders and McCormick, 1993:5).

Evolutionary Prototyping. A specific type of prototyping that is used to uncover unknown requirements and continues to evolve into the fully functional system (Davis, 1992:71).

Expert System. A general term used to refer to knowledge-based systems, and to describe a wide range of advanced computer systems variously described as decision support systems, executive information systems, management information systems, and executive support systems (Mockler and Dologite, 1992:774).

Heuristics. Rules of thumb or other strategies used in problem-solving or decision making (Mockler and Dologite, 1992:774).

Information System. An open purposive system that produces information using the input/process/output cycle. The minimal information system consists of people, procedures, and data (Kroenke, 1992:782).

Interoperability. The capacity to integrate technology between or among different technical platforms (CIM, 1993:159).

Knowledge-Based System. A computer system that attempts to replicate specific human expert intelligent activities (Mockler and Dologite, 1992:774).

Knowledge Domain. A field of knowledge that can be defined by scope, range, depth, and/or breadth (ibid).

Knowledge Engineer. An individual who accomplishes KBS development jobs of situational analysis and representation, and computer system design and implementation (ibid).

Operational Prototyping. A prototyping approach that combines the rapid results of the throwaway prototype and the stability of the evolutionary prototype (Davis, 1992:73).

Throwaway Prototyping. A prototyping approach that is used to discover which requirements are real and which are not. This prototype is discarded after the desired information is learned (ibid:71).

Appendix B: Answers from the Unstructured Interviews

I. LCOM

The researchers asked all of the questions to the expert so as to give him an idea of the direction the interview would take. The expert stated that the steps that occur in whenever a COEA is received would be the best framework to answer all the other questions.

5. Steps that occur when you receive a COEA?

First, all the representatives are called together in a big meeting to decide whether XRE can produce the required answers for the COEA Request. Some of the initial screening questions are:

-- Does XRE have a valid scenario to fit this COEA?

-- Does XRE have applicable databases to fit this scenario (i.e. a Campaign/Threat model for TAC THUNDER, a Supportability model for LCOM, a Cost model, etc...)?

4. What are the critical factors or conditions that need to be met (i.e. type of aircraft used in COEA)?

The overall area for critical factors would be in understanding the proposed modification. Each main area of concern would be a Description of the Modification, LCOM database for the specific aircraft that the modification is proposed for, a database for the scenario to be modeled, and

familiarization and debugging of the database within the LCOM simulation model framework.

Description of Modification:

- Does the COEA Request have a Engineering Change Proposal (ECP)?

-- Requires a Yes and No branching. The Yes branch should then flow into next D of M question. The No branch should specify that the validity of the COEA needs to be verified with the System Program Office (or other sources) to get a copy of the ECP.

- Is the Logistics Support Analysis data available?

-- Each question within this section requires a Yes and No branching. The Yes branch should skip the subsequent possible sources of data for the model and proceed to the next area Task Times for Maintenance. The No branch should then flow into the next possible source for model data.

- Existing data on comparable equipment?
- Existing data in historical database?
- Existing data in other databases (i.e. Navy, commercial, etc)?

Task Times for Maintenance:

- Sequence of maintenance tasks?

-- Each question within this section requires a Yes and No branching. The Yes branch should flow into the

next question within this section since all these questions are required for the LCOM model. The No branch should also flow into each question since this checklist is to determine which information is at hand and which is needed.

- Resource requirements?
- Task times for completion of task?
- Maintenance crew size data?
- Support facilities?
- Reliability values?

LCOM Database (DB) Familiarization/Debug:

- Is there an LCOM DB with specific aircraft for the scenario?

-- Each question within this section requires a Yes and No branching. The Yes branch then flows into the next question within this section. The No branch then asks if there is a DB available from other sources.

- Is DB available in-house?
- Other sources of DB (MAJCOM, Navy, commercial, generic)?

When DB is Available:

- Compare to current COEA scenario by checking the same flying schedule (peace/wartime/other)?

-- Each question in this section requires a Yes and No branching. The Yes branch will flow into the next question from within this section. The No branch will

also flow into the next question to determine which portions of the DB need to be modified to fit the current scenario.

- Same types of missions?

DB Integrity Check:

- If DB has never been run through LCOM simulation model, Then run DB through the simulation model. This is the quickest way to check integrity of the DB.

-- If integrity of the DB is verified, then the information gathering process is complete.

-- If integrity is bad, determine from the error messages from LCOM simulation model what the magnitude of the data errors are. If possible, fix the errors. If not, then DB will be rejected and another sought out or built.

The following questions were never readdressed by the researchers since they all were answered by the previous answers and scenarios as presented by the expert.

1. What rules/regulations/procedures (formal and informal) are used everytime that require information to be answered?

2. What kinds of data or knowledge is needed to reach the decisions required by the COEA?

3. Describe a typical problem for each decision?

II. TAC THUNDER

Unstructured Interview

Captain Dave McCormick 9 Jul 93

Steps in the COEA Process...

Critical Factors

A. Establish Year/Timeframe

Is the scenario consistent/nonconsistent?

Have several years over the lifetime of the system been indicated?

B. Select proper Defense Planning Guidance (DPG)-based scenario for COEA effectiveness analysis

Are the scenarios traceable back to DPG/IPS?

Do the scenarios seem contrived?

Do the scenarios identify the mission tasking for the alternatives?

Does one of the scenarios provide a stressful case?

Does one of the scenarios provide an unlikely case?

Does one of the scenarios provide a likely case?

Do the scenarios present a good operational range of possibilities?

C. Establish a baseline DB for TT (at least 2 theaters should be examined)

If only one theater selected, has the rationale been documented?

Are the DPG/IPS scenarios built on the validated threat?

Are blue systems a/c & ground assets correctly modeled (performance, lethality, sortie rates, etc)?

Has user/sponsor reviewed proposed scenario DB?

Are changes required?

If yes, incorporate changes.

D. Define Functional Objectives (FOs)

Have the mission tasks been identified for the system based on the need?

(Ensure model generates appropriate data based on mission need)

Are the mission tasks quantifiable?

(Has the mission task been quantified?)

E. Concept of operations (CONOPs)

Is the employment of the system feasible?

Is the operations and maintenance force structure valid?

Are interfaces with other systems considered?

F. List of Alternatives

Is each alternative described in detail?

Has the (current system) baseline case been identified?

Has an adequate range of alternatives been identified?

Do the alternatives consider changes in requirements?

Are the current or prospective systems reasonable alternatives?

Have you explained the rationale for non-selection of alternatives?

Appendix C: Decision Tables

I. LCOM Prototype

1. Description of Modification

Rule	Qualifier	Choice	Recommendation
A 1	ECP Provided w/ COEA	Y/N	Proceed/Check validity of COEA
A 2	LSA A/C data avail?	Y/N	Proceed/Check other sources
A 3	Other AF MNX data avail?	Y/N	Proceed/Check other sources
A 4	Historical AF DB avail?	Y/N	Proceed/Check other sources
A 5	Other Non-AF DB avail?	Y/N	Proceed/COEA not possible
A 6	Or any one is Y	Y	Proceed
A 7	If all are N		Stop COEA warning message

2. Task Times For MNX

A 8	Sequence Mnx Tasks avail?	Y/N	Proceed/Look for comparable data
A 9	Resource reqs avail?	Y/N	Proceed/Ask expert
A 10	Task time for each task?	Y/N	Proceed/Ask expert
A 11	Mnx Crew specs avail?	Y/N	Proceed/Look for comparable data
A 12	Support facilities specs?	Y/N	Proceed/Look for comparable data

A 13	Reliability values avail?	Y/N	Proceed/Look for comparable data
A 14	Else resolve any NOs		COEA must stop

3. LCOM DB Familiarization/Debug

A 15	Specific LCOM DB scenario?	Y/N	Proceed/Look at other scenario sources
A 16	Scenario avail in-house?	Y/N	Proceed/Look at other scenario sources
A 17	Other scenario sources?	Y/N	Proceed/COEA not possible

4. When DB Avail, Compare to Scenario

A 18	Same flying schedule?	Y/N	Proceed/Modify scenario
A 19	Same types of mission?	Y/N	Proceed/Modify scenario

5. DB Integrity Check

A 20	Has DB been run in model?	Y/N	Proceed/Run in model
A 21	What were results of run?	G/B	Proceed/Investigate errors for magnitude of fix needed

II. TAC THUNDER Prototype

1. Establish Year/Timeframe

Rule	Qualifier	Choice	Recommendation
A 1	Scenario year consistent	Y/N	Proceed/Review
A 2	Several years identified	Y/N	Proceed/Ask expert

2. Select Proper (DPG)-Based Scenarios Analysis

A 3	Scenarios traceable	Y/N	Proceed/Provide rationale
A 4	Scenarios appropriate	Y/N	Proceed/Review
A 5	Scenarios identify mission	Y/N	Proceed/Get listing
A 6	Scenarios stressful	Y/N	Proceed/Review
A 7	Scenarios likely	Y/N	Proceed/Review
A 8	Scenarios good range	Y/N	Proceed/Consider other scenarios

3. Establish A Baseline DB For TT

A 9	Theaters more than one	Y/N	Proceed/Get expert
A 10	Scenarios threat	Y/N	Proceed/Obtain STAR
A 11	Blue assets correct	Y/N	Proceed/Review
A 12	Expert reviewed	Y/N	Proceed/Get expert

4. Define Functional Objectives (FOs)

A 13	Tasks identified	Y/N	Proceed/Coordinate
A 14	Tasks quantified	Y/N	Proceed/Develop

5. Concept Of Operations (CONOPs)

A 15	Employment feasible	Y/N	Proceed/Review
A 16	Structure valid	Y/N	Proceed/Review
A 17	Interfaces considered	Y/N	Proceed/Obtain data

6. List Of Alternatives

A 18	Alternative in detail	Y/N	Proceed/Obtain detail
A 19	Baseline identified	Y/N	Proceed/Review
A 20	Alternatives identified	Y/N	Proceed/Review
A 21	Alts consider change	Y/N	Proceed/Review
A 22	Are Systems alternatives	Y/N	Proceed/Review
A 23	Non-Selection explained	Y/N	Proceed/Document

III. COEA Gatherer

Rule	Qualifier	Choice	Recommendation
	1. General Requirements		
1	Scenario is Peacetime	Y/N	Send info on
2	Scenario is Wartime	Y/N	Send info on
3	Scenario is other	Y/N	Resolve with user
4	Scenario/IOC yr consistent	Y/N	Send info on/ Review with user
5	ECP available	Y/N	Send info on/ Check validity
30	General Rqmts all avail	Y/N	
	2. Facilities and Deployment		
6	Num locations and # ac at each site determined	Y/N	Send info on/ Get info
7	Supply concept determined	Y/N	Send info on/ Get info
8	Resupply time determined	Y/N	Send info on/ Get info
9	Extent of maintenance capability determined	Y/N	Send info on/ Get info
10	Shelter determined at each site	Y/N	Send info on/ Get info
11	Facilities & Support equipment determined	Y/N	Send info on/ Get info
31	All Facilities & Deployment info available	Y/N	
	3. Mission Requirements		
12	Mission types determined	Y/N	Send info on/ Get info
13	AC Config for each mission determined	Y/N	Send info on/ Get info

14	Mission priorities determined	Y/N	Send info on/ Get info
15	Mission cancellation delay time tolerances determined	Y/N	Send info on/ Get info
16	Mission tasks for system based on need determined	Y/N	Send info on/ Get info
34	All Mission Rqmts info available	Y/N	

4. Operations and Scheduling Policy

17	Aircraft sortie rates determined	Y/N	Send info on/ Get info
18	Requirements for complementary missions determined	Y/N	Send info on/ Get info
19	Interfaces with other systems have been considered	Y/N	Send info on/ Review with user
20	Interface data is available	Y/N	Send info on/ Get info
21	Interfaces w/ other systems been considered and appropriate interface data is: not available	Y/N	Get info
22	Number of ac on alert at each site available	Y/N	Send info on/ Get info
35	All Ops and Sched info avail	Y/N	

5. Ground Alert

23	Missions to be flown from alert determined	Y/N	Send info on/ Get info
24	Frequency of alert missions determined	Y/N	Send info on/ Get info
25	Alert replacement policy determined	Y/N	Send info on/ Get info
32	All Ground Alert info available	Y/N	

6. Maintenance Concepts & Operations

26	Maintenance concept determined	Y/N	Send info on/ Get info

27	Organizational structure & maintenance concept match	Y/N	Send org info on/ Resolve with user
28	AFSC structure & org structure in compliance	Y/N	Send AFSC info on/ Resolve with user
29	AFSC structure & maint concept level in compliance	Y/N	Send AFSC info on/ Resolve with user
33	All Maint Concept & Ops info available	Y/N	

7. Overall Recommendation

36	General Requirements and Facilities & Deployment and Missions Rqmts and Ops & Sched Policy and Ground Alert and Maint Concepts & Organization info avail	Y/N	Proceed to send info to LCOM and TAC THUNDER/ Not all info is available for LCOM and TAC THUNDER to process this COEA

Appendix D: Dependency Diagrams

I. LCOM

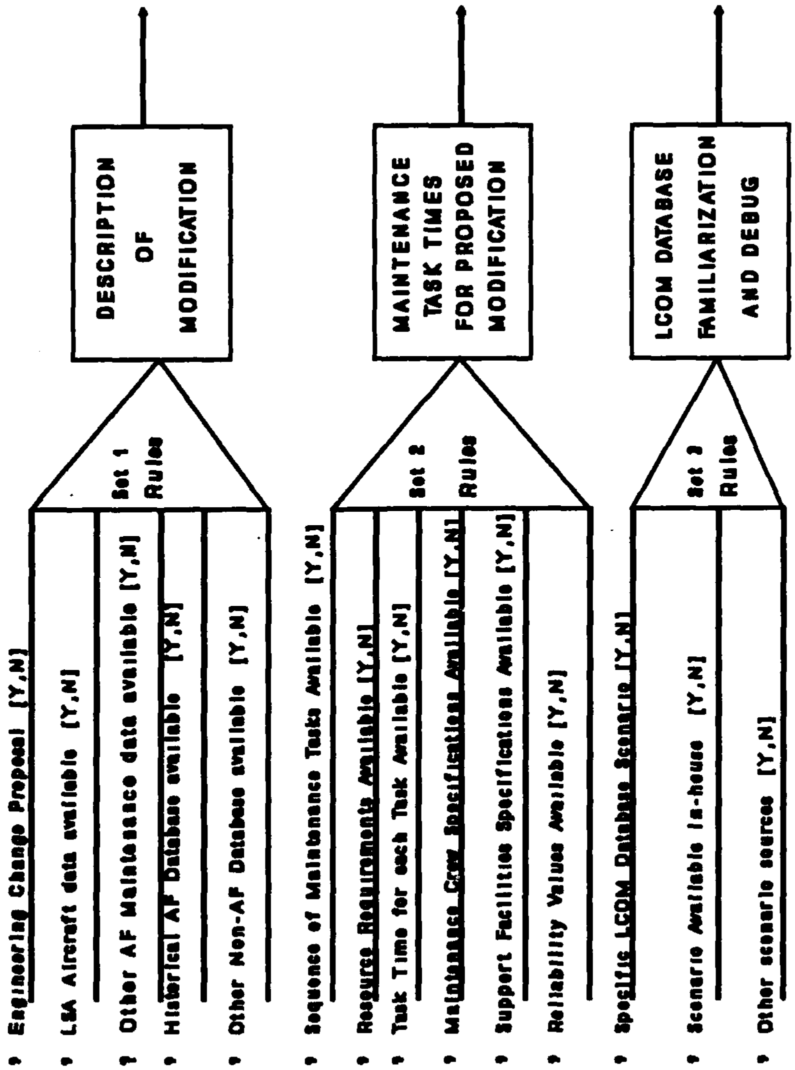

Figure 8. Dependency Diagram 1 -- LCOM

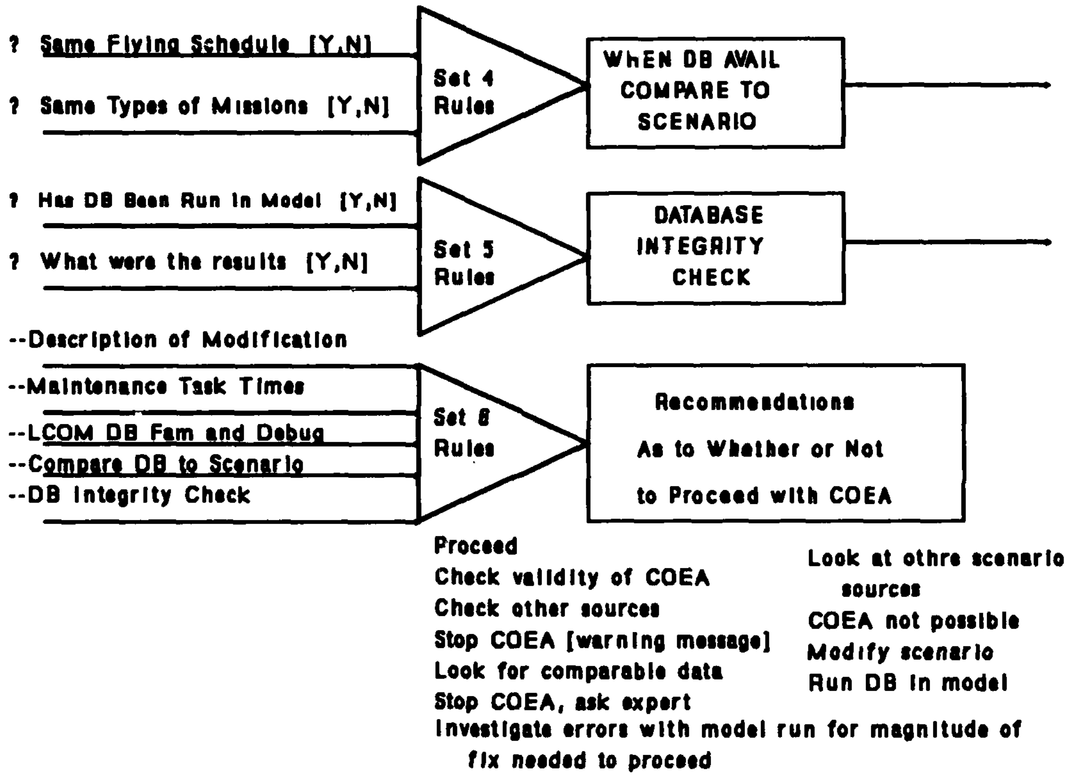

Figure 9. Dependency Diagram 2 -- LCOM

II. TAC THUNDER

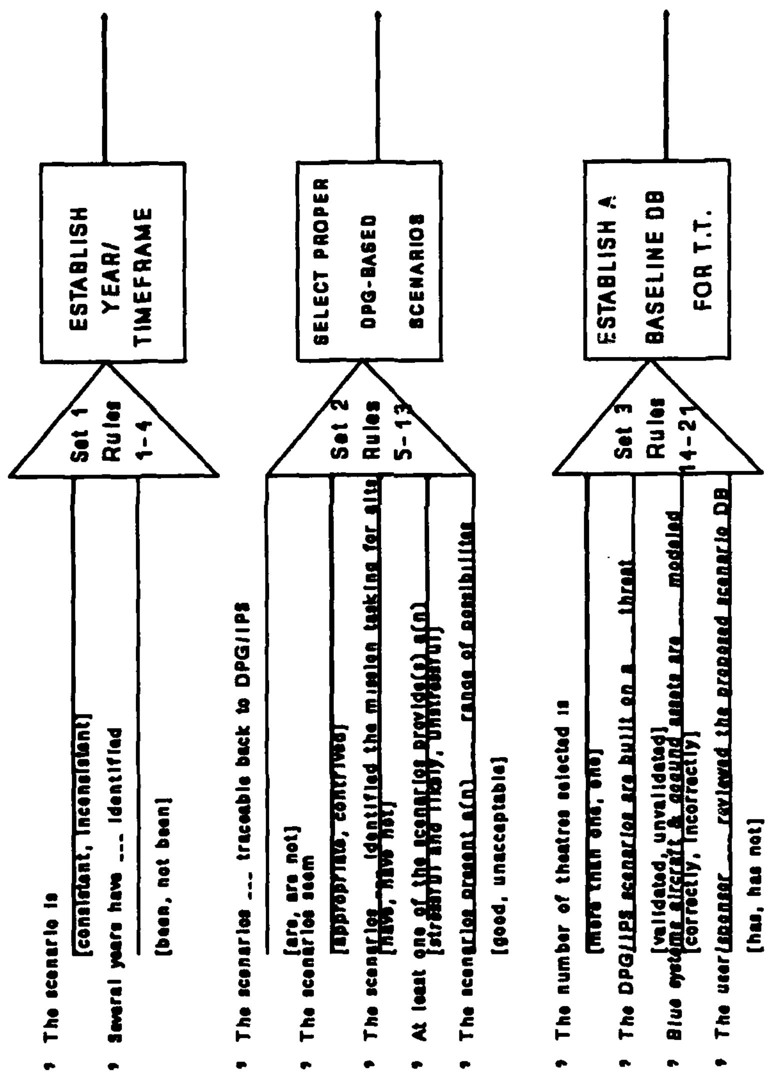

Figure 10. Dependency Diagram 1 -- TAC THUNDER

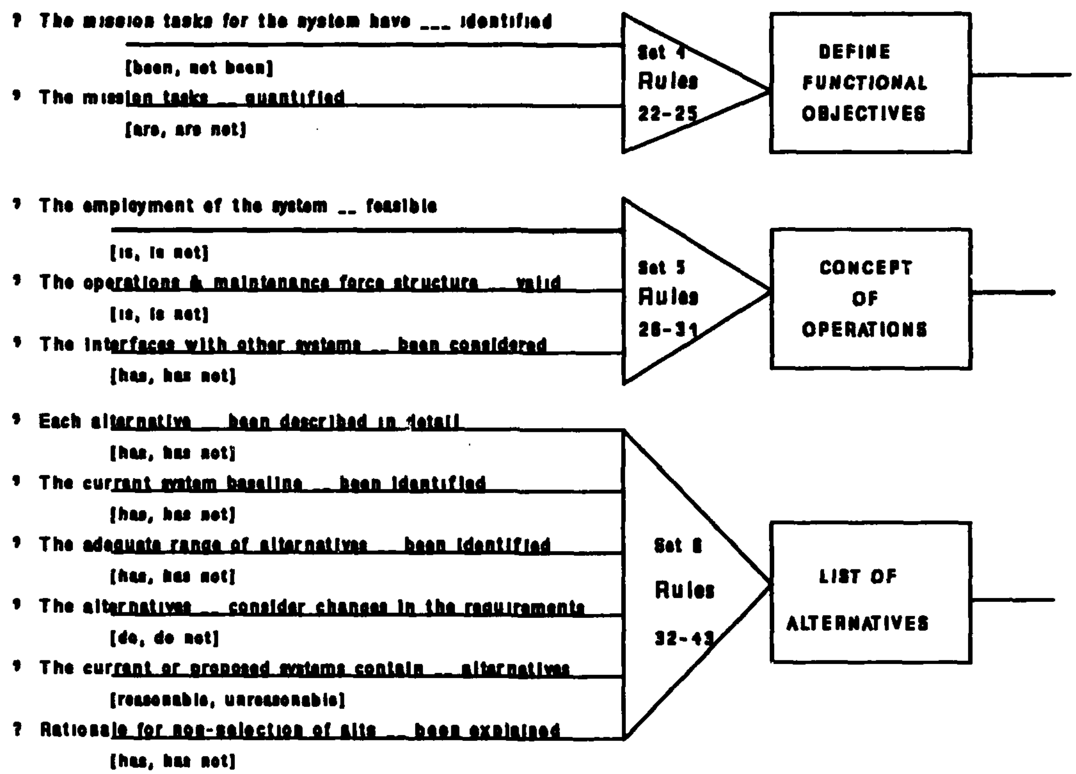

Figure 11. Dependency Diagram 2 -- TAC THUNDER

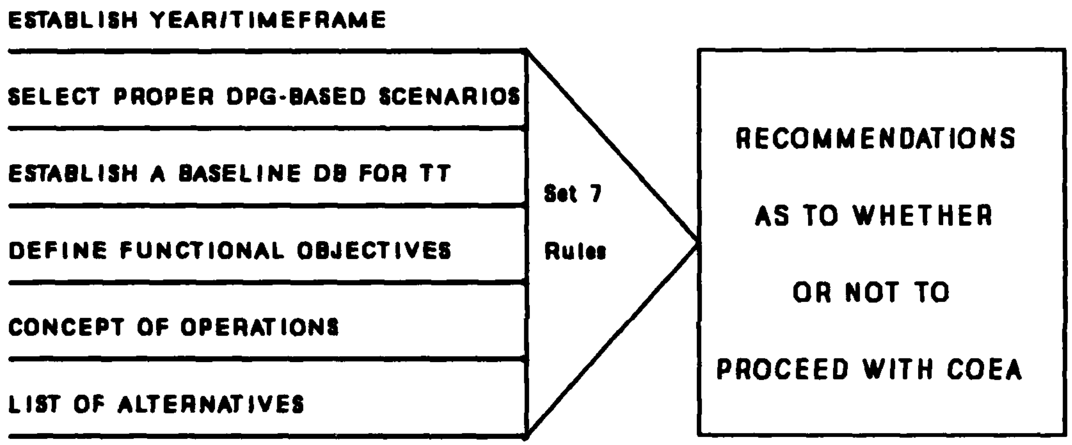

Figure 12. Dependency Diagram 3 -- TAC THUNDER

III. COEA Gatherer

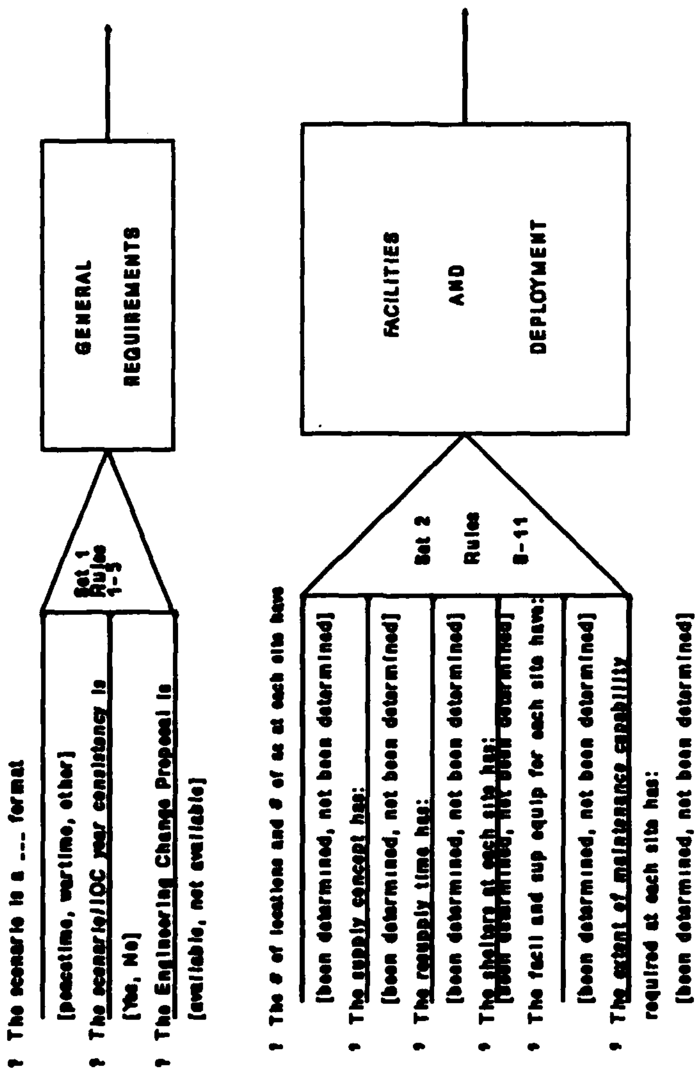

Figure 13. Dependency Diagram 1 -- COEA Gatherer

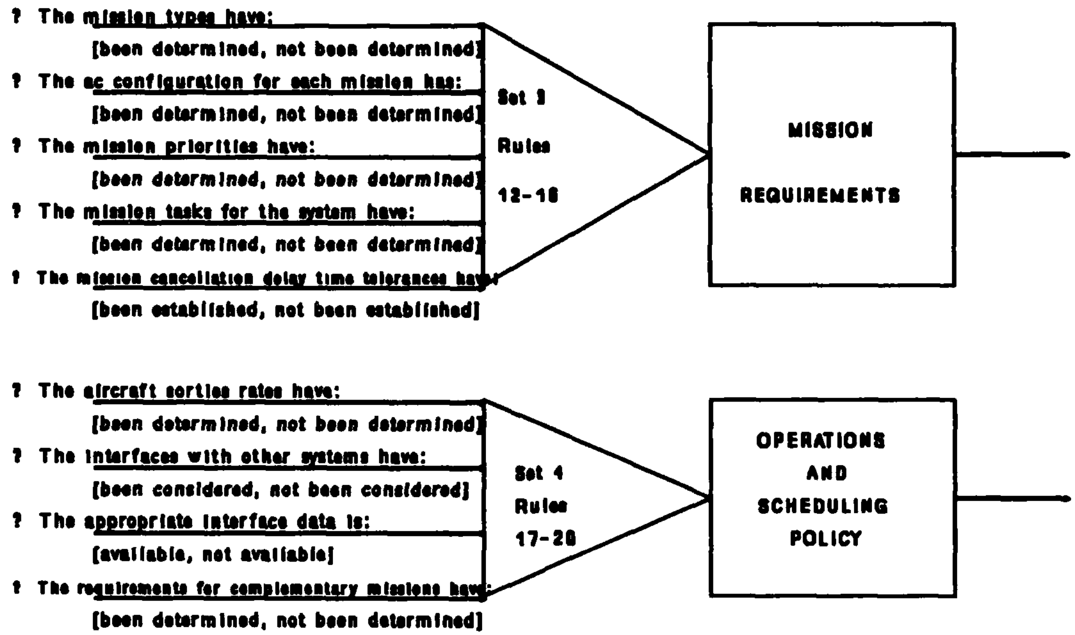

Figure 14. Dependency Diagram 2 -- COEA Gatherer

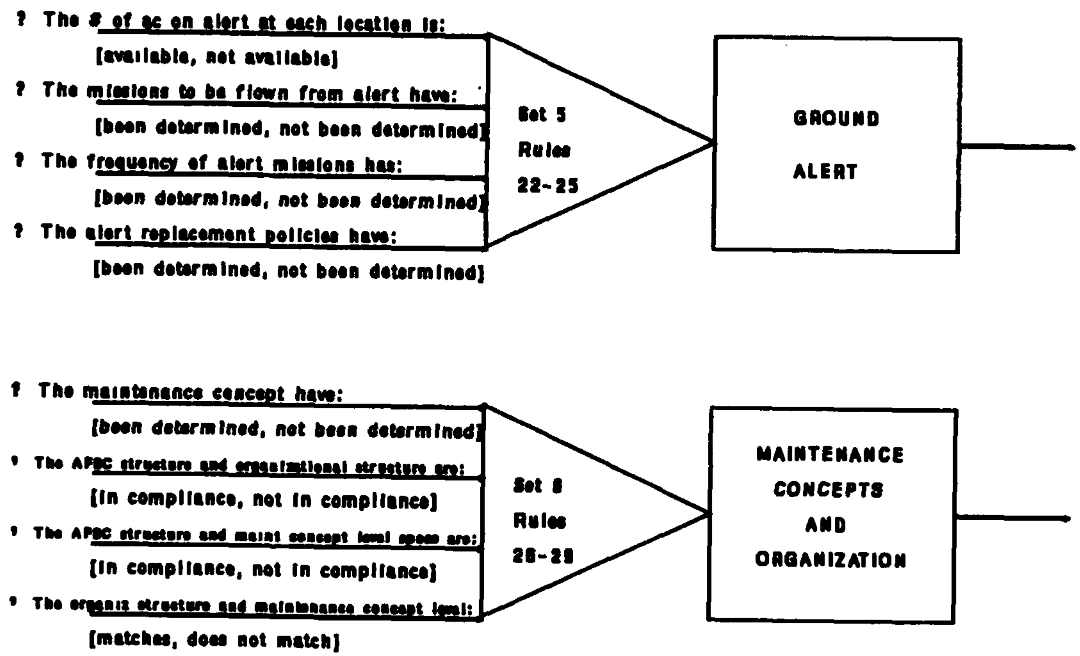

Figure 15. Dependency Diagram 3 -- COEA Gatherer

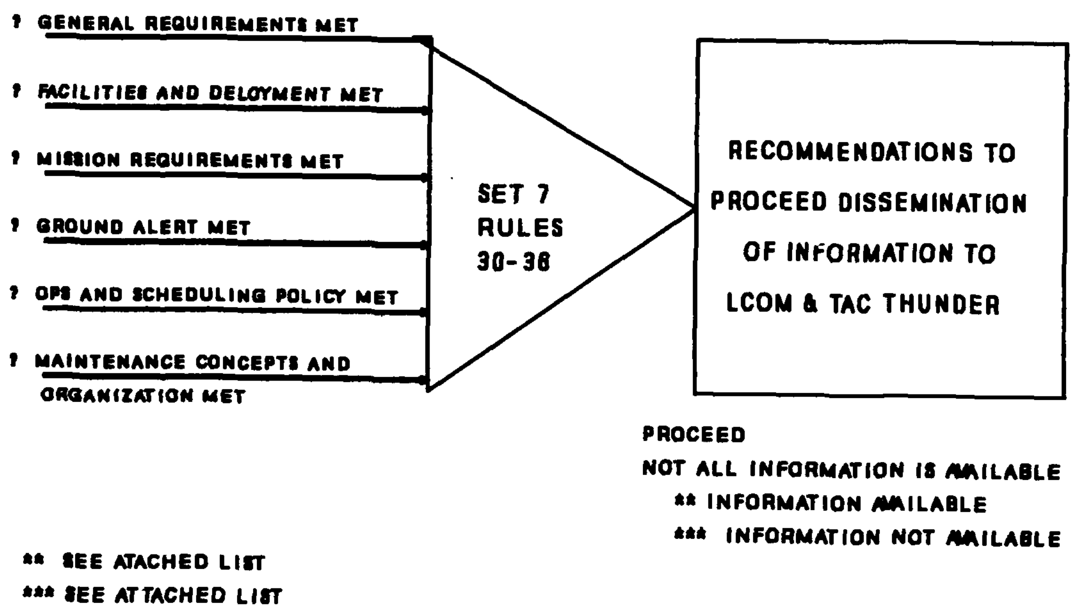

Figure 16. Dependency Diagram 4 -- COEA Gatherer

Available Information:

The scenario/IOC year is:

The Engineering Change Proposal information is:

The numbers and locations of aircraft at each site are:

The supply concept is:

The resupply time is:

The maintenance capability required at each site is:

The shelter information at each site is:

Facilities and support equipment rqmts for each site are:

The mission types are:

The aircraft configuration for each mission is:

The mission priorities are:

The tolerances for mission delay time are:

The mission tasks for the system are:

The aircraft sortie rates are:

The requirements for complementary missions are:

The interfaces with other systems and their data are:

The number of aircraft on alert at each location is:

Missions to be flown from alert are:

The frequency of alert missions is:

The alert replacement policy is:

The maintenance concept to be used is:

The organization structure is:

The AFSC structure is:

Information is not available or incompatible:

LCOM and TAC THUNDER are not designed for scenarios other than Peacetime or Wartime

See COEA focal point for further guidance

Review scenario/IOC year with user to resolve and/or verify discrepancy

Check validity of Engineering Change Proposal with user

Get numbers and locations of ac at each site from users

Get the supply concept information from user

Get the resupply time information from user

Get extent of mnx capability required at each site from user

Get the shelter information for each site from user

Get facil & support eqpmnt rqmnts for each site from user

Get the mission types from user

Get the aircraft configuration for each mission from user

Get the user to establish mission priorities

Get user to determine mission delay time tolerances

Coordinate with user to formulate tasks and/or study measures for alternatives being examined

Get aircraft sortie rates from user

Get user to determine rqmts for complementary missions

Review the lack of interface data with user

Get data for interface systems from user

Get number of aircraft on alert at each location from user

Get missions to be flown from alert information from user

Get frequency of alert missions information from user

Get alert replacement policy information from user

Get user to determine maintenance concept to be used

Get with user to rectify organization structure and maintenance concept level

Get with user to rectify differences in AFSC structure, organization structure, and maintenance concept level

Appendix E: IF-THEN Rules

I. LCOM

RULES:

RULE NUMBER: 1
IF:
the Engineering Change Proposal provided with the COEA is available
THEN:
Proceed with the COEA Information Gathering Process. ECP availability is at - Confidence=10/10

RULE NUMBER: 2
IF:
the Engineering Change Proposal provided with the COEA is not available

THEN:
Check the validity of the Proposed COEA with the Systems Program Office and , if necessary, consult with the COEA expert. ECP nonavailability is at - Confidence=10/10

RULE NUMBER: 3
IF:
the Logistics Support Analysis aircraft data is available
or other Air Force maintenance data is available
or a historical Air Force Maintenance Database (DB) is available
or other Non-AF DB are available

THEN:
Proceed with the COEA Information Gathering Process. The necessary Analysis Data availability is at - Confidence=10/10

RULE NUMBER: 4
IF:
the Logistics Support Analysis aircraft data is not available
and other Air Force maintenance data is not available
and a historical Air Force Maintenance Database (DB) is not available
and other Non-AF DB are not available

THEN:

Check the validity of the COEA Proposal with the Systems Program Office and the COEA expert since there is no Analysis Data available at - Confidence=10/10

RULE NUMBER: 5

IF:

the sequence of maintenance tasks to be performed is available

and the resource requirements for each specific maintenance task are available

and the task time for each maintenance task to be performed is available

and the specifications for each maintenance crew required to perform each maintenance task are available

and the support facilities required for each maintenance task to be performed are available

and the reliability values required for each maintenance task to be performed are available

THEN:

Continue the COEA Information Gathering Process. The Specific Task Data availability is at - Conf. = 10/10

RULE NUMBER: 6

IF:

the sequence of maintenance tasks to be performed is not available

or the resource requirements for each specific maintenance task are not available

or the task time for each maintenance task to be performed is not available

or the specifications for each maintenance crew required to perform each maintenance task are not available

or the support facilities required for each maintenance task to be performed are not available

or the reliability values required for each maintenance task to be performed are not available

THEN:

Look for comparable data that matches the Specified Task Data or ask the COEA expert for guidance in finding data for that specific task area. The nonavailability of the Specific Task Data is at - Conf. = 10/10

RULE NUMBER: 7
IF:
the specific LCOM DB scenario is available in-house

THEN:
Proceed with the COEA Information Gathering Process.
The Scenario availability is at - Conf. = 10/10

RULE NUMBER: 8
IF:
the specific LCOM DB scenario is not available in-house

THEN:
Check other sources with the same type of aircraft as indicated in the COEA Proposal (like MAJCOMs, other services, or commercial aviation services) to get the needed Scenario specific data. The need for Scenario specific data is at - Confidence=10/10

RULE NUMBER: 9
IF:
the flying schedule within the DB is the same

THEN:
Continue with the COEA Information Gathering Process.
The availability of the DB is at- Conf. = 10/10

RULE NUMBER: 10
IF:
the mission types within the scenario to be used are the same

THEN:
Continue with the COEA Information Gathering Process.
The availability of the DB is at- Conf. = 10/10

RULE NUMBER: 11
IF:
the flying schedule within the DB is different
or the mission types within the scenario to be used are different

THEN:
Modify the scenario to fit the required parameters.
The need to modify the DB is at- Conf. = 10/10

RULE NUMBER: 12
IF:
the DB to be used has been run within the LCOM simulation model

THEN:
Proceed with the COEA Information Gathering Process. The DB Integrity Check is at - Conf. = 10/10

RULE NUMBER: 13
IF:
the DB has been run within the LCOM simulation model, and the results are good

THEN:
The COEA Information Gathering Process is now complete. Inform the COEA expert that all the required information is now in-hand and that the COEA Proposal is ready to be run - Conf. = 10/10

RULE NUMBER: 14
IF:
the DB to be used has not been run within the LCOM simulation model

THEN:
Run the DB through the LCOM simulation model. The need for a DB Integrity Check is at- Conf. = 10/10

RULE NUMBER: 15
IF:
the DB has been run within the LCOM simulation model, and the results are bad

THEN:
Investigate the errors specified from the DB Integrity Check by the LCOM simulation model. Determine the magnitude of the corrections necessary. The need to bring the DB up to the necessary integrity is at - Conf. = 10/10

II. TAC THUNDER Prototype

RULES:

RULE NUMBER: 1
IF:
the scenario year is consistent

THEN:
Proceed with COEA Information Gathering Process. The year of study consistency is at - Confidence=1

RULE NUMBER: 2
IF:
the scenario year is inconsistent

THEN:
Review the consistency of the study year with the study leader. Study year inconsistency is at - Confidence=1

RULE NUMBER: 3
IF:
several years have been identified

THEN:
Proceed with COEA Information Gathering Process. The availability of the necessary number of study years is at - Confidence=1

RULE NUMBER: 4
IF:
several years have not been identified

THEN:
Ask study leader if single year analysis is acceptable. Availability of only a single study year is at - Confidence=1

RULE NUMBER: 5
IF:
the scenarios are traceable back to DPG/IPS

THEN:
Proceed with COEA Information Gathering Process. The traceability of the scenarios is at - Confidence=1

RULE NUMBER: 6
IF:
the scenarios are not traceable back to DPG/IPS

THEN:
Provide rationale from user/sponsor for use of non-DPG/IPS scenarios. Use of non-DPG/IPS scenarios is at - Confidence=1

RULE NUMBER: 7
IF:
the scenarios seem appropriate

THEN:
Proceed with COEA Information Gathering Process. The appropriateness of the scenarios used is at - Confidence=1

RULE NUMBER: 8
IF:
the scenarios seem contrived

THEN:
Review scenario problems with study leader. Document/provide rationale for questionable areas and get study leader approval to continue process. - Confidence=1

RULE NUMBER: 9
IF:
the scenarios have identified the mission tasking for the alternatives

THEN:
Proceed with COEA Information Gathering Process. The likelihood that the scenarios do identify tasking alternatives is at - Confidence=1

RULE NUMBER: 10
IF:
the scenarios have not identified the mission tasking for the alternatives

THEN:
Get a complete listing of mission taskings from the user/sponsor. The need for this listing is at - Confidence=1

RULE NUMBER: 11
IF:
at least one of the scenarios provide(s) a(n) stressful and likely cases

or: at least one of the scenarios provide(s) a(n) unlikely case

THEN:
Proceed with COEA Information Gathering Process. The likelihood that the scenarios provide all cases is at - Confidence=1

ELSE:
Review scenario cases with the study leader. The likelihood of a problem with one or more of the scenarios is at - Confidence=1

RULE NUMBER: 12
IF:
the scenarios present a(n) good operational range of possibilities

THEN:
Proceed with COEA Information Gathering Process. The proposed scenarios do present a good range of possibilities is at - Confidence=1

RULE NUMBER: 13
IF:
the scenarios present a(n) unacceptable range of possibilities

THEN:
Consider adding additional scenario(s) to get a good operational range. - Confidence=1

RULE NUMBER: 14
IF:
the number of theaters selected is more than one

THEN:
Proceed with COEA Information Gathering Process. Theater selection is at - Confidence=1

RULE NUMBER: 15
IF:
the number of theaters selected is one

THEN:

Get/provide rationale from the user/sponsor for a one theater option. If no rationale forthcoming, get study leader approval before continuing process. - Confidence=1

RULE NUMBER: 16

IF:

the DPG/IPS scenarios are built on a validated threat

THEN:

Proceed with COEA Information Gathering Process. Good threat assessment is at - Confidence=1

RULE NUMBER: 17

IF:

the DPG/IPS scenarios are built on a nonvalidated threat

THEN:

Obtain STAR (System Threat Assessment Report) from FASTC. The need for this information is at - Confidence=1

RULE NUMBER: 18

IF:

blue systems aircraft and ground assets are correctly modeled

THEN:

Proceed with COEA Information Gathering Process. The correct representation of the blue forces is at - Confidence=1

RULE NUMBER: 19

IF:

blue systems aircraft and ground assets are incorrectly modeled

THEN:

Contact mission level office for a review of blue system assets. - Confidence=1

RULE NUMBER: 20

IF:

the user/sponsor has reviewed the proposed scenario database

THEN:

Proceed with COEA Information Gathering Process. The need for user/sponsor review of the proposed scenario is at - Confidence=1

RULE NUMBER: 21
IF:

the user/sponsor has not reviewed the proposed scenario database

THEN:

Get approval/coordination from study leader and user/sponsor. Incorporate any changes noted. - Confidence=1

RULE NUMBER: 22
IF:

the mission tasks for the system have been identified based on need

THEN:

Proceed with COEA Information Gathering Process. The identification of mission tasks based upon need is at - Confidence=0

RULE NUMBER: 23
IF:

the mission tasks for the system have not been identified based on need

THEN:

Coordinate with study leader to formulate appropriate tasks and/or study measures for the alternatives being examined. - Confidence=1

RULE NUMBER: 24
IF:

the mission tasks are quantified

THEN:

Proceed with COEA Information Gathering Process. The quantification of mission tasks is at - Confidence=1

RULE NUMBER: 25
IF:

the mission tasks are not quantified

THEN:

Develop quantifiable mission objectives/tasks. - Confidence=1

RULE NUMBER: 26
IF:

the employment of the system is feasible

THEN:

Proceed with COEA Information Gathering Process. The feasibility of the employment portion of the study is at - Confidence=1

RULE NUMBER: 27
IF:

the employment of the system is not feasible

THEN:

Review employment concept with user/sponsor. - Confidence=1

RULE NUMBER: 28
IF:

the operations and maintenance force structure is valid

THEN:

Proceed with COEA Information Gathering Process. The validity of the overall force structure is at - Confidence=1

RULE NUMBER: 29
IF:

the operations and maintenance force structure is not valid

THEN:

Review force structure with user/sponsor. - Confidence=1

RULE NUMBER: 30
IF:

the interfaces with other systems have been considered

THEN:

Proceed with COEA Information Gathering Process. The consideration of other interfaces is at - Confidence=1

RULE NUMBER: 31
IF:
the interfaces with other systems have not been considered

THEN:
Obtain interface data from user/sponsor. - Confidence=1

RULE NUMBER: 32
IF:
each alternative has been described in detail

THEN:
Proceed with COEA Information Gathering Process. Each alternative's description is at - Confidence=1

RULE NUMBER: 33
IF:
each alternative has not been described in detail

THEN:
Obtain necessary description details from user/sponsor. - Confidence=1

RULE NUMBER: 34
IF:
the current system baseline has been identified

THEN:
Proceed with COEA Information Gathering Process. The baseline case identification is at - Confidence=1

RULE NUMBER: 35
IF:
the current system baseline has not been identified

THEN:
Review baseline case with user/sponsor. - Confidence=1

RULE NUMBER: 36
IF:
the adequate range of alternatives has been identified

THEN:

Proceed with COEA Information Gathering Process. The availability of an adequate range is at - Confidence=1

RULE NUMBER: 37

IF:

the adequate range of alternatives has not been identified

THEN:

Review proposed range with study leader and user/sponsor. Provide rationale for proposed range. - Confidence=1

RULE NUMBER: 38

IF:

the alternatives do consider changes in the requirements

THEN:

Proceed with COEA Information Gathering Process. The adequacy of the changes considered is at - Confidence=1

RULE NUMBER: 39

IF:

the alternatives do not consider changes in the requirements

THEN:

Review with study leader and user/sponsor. Provide rationale for this consideration of requirements. - Confidence=1

RULE NUMBER: 40

IF:

the current or prospective systems contain reasonable alternatives

THEN:

Proceed with COEA Information Gathering Process The reasonableness of the alternatives is at - Confidence=1

RULE NUMBER: 41

IF:

the current or prospective systems contain unreasonable alternatives

THEN:

Review with study leader and user/sponsor. Document rationale for using specified alternatives. - Confidence=1

RULE NUMBER: 42

IF:

the rationale for the non-selection for alternatives has been explained

THEN:

Proceed with COEA Information Gathering Process. Non-selection rationale availability is at - Confidence=1

RULE NUMBER: 43

IF:

the rationale for the non-selection for alternatives has not been explained

THEN:

Document rationale for non-selection of alternatives. - Confidence=1

III. Gatherer Prototype

RULES:

RULE NUMBER: 1 (GENERAL RQMTS--2)
IF:
The scenario is a __ format: Peacetime

THEN:
Scenario is Peacetime - Confidence=1

RULE NUMBER: 2 (GENERAL RQMTS--3)
IF:
The scenario is a __ format: Wartime

THEN:
Scenario is Wartime - Confidence=1

RULE NUMBER: 3 (GENERAL RQMTS--4)
IF:
The scenario is a __ format: other

THEN:
LCOM and TAC THUNDER are not designed for scenarios other than Peacetime or Wartime - Confidence=1 and See COEA focal point for further guidance - Confidence=1

RULE NUMBER: 4 (GENERAL RQMTS--5)
IF:
The scenario/IOC year consistency is: No

THEN:
Review scenario/IOC year with user to resolve and/or verify discrepancy - Confidence=1

ELSE:
The scenario/IOC year is: - Confidence=1

RULE NUMBER 5 (GENERAL RQMTS--6)
IF
The Engineering Change Proposal is not available

THEN
Check validity of Engineering Change Proposal with user - Confidence=1

ELSE:

The Engineering Change Proposal information is: - Confidence=1

RULE NUMBER: 6 (F&D--2)

IF:

The number of locations and number of aircraft at each site have: not been determined

THEN:

Get the numbers and locations of aircraft at each site from users - Confidence=1

ELSE:

The numbers and locations of aircraft at each site are: - Confidence=1

RULE NUMBER: 7 (F&D--3)

IF:

The supply concept (for example:deploy with War Readiness Spares Kit for xxx days) has: not been determined

THEN:

Get the supply concept information from user - Confidence=1

ELSE:

The supply concept is: - Confidence=1

RULE NUMBER: 8 (F&D--4)

IF:

The resupply time has: not been determined

THEN:

Get the resupply time information from user - Confidence=1

ELSE:

The supply concept is: - Confidence=1

RULE NUMBER: 9 (F&D--5)

IF:

The extent of maintenance capability required at each site has: not been determined

THEN:

Get the extent of maintenance capability required at each site from user - Confidence=1

ELSE:

The maintenance capability required at each site is: - Confidence=1

RULE NUMBER: 10 (F&D--6)

IF:

The shelters at each site has: not been determined

THEN:

Get the shelter information for each site from user - Confidence=1

ELSE:

The shelter information at each site is: - Confidence=1

RULE NUMBER: 11 (F&D--7)

IF:

The facilities and support equipment for each site have: not been determined

THEN:

Get the facilities and support equipment requirements for each site from user - Confidence=1

ELSE:

The facilities and support equipment requirements for each site are: - Confidence=1

RULE NUMBER: 12 (MR--2)

IF:

The mission types (for example: Interdiction; Combat Air Patrol) have: not been determined

THEN:

Get the mission types from user - Confidence=1

ELSE:

The mission types are: - Confidence=1

RULE NUMBER: 13 (MR--3)

IF:

The aircraft configuration for each mission has: not been determined

THEN:

Get the aircraft configuration for each mission from user - Confidence=1

ELSE:

The aircraft configuration for each mission is: - Confidence=1

RULE NUMBER: 14 (MR--4)
IF:

The mission priorities have: not been determined

THEN:

Get the user to establish mission priorities - Confidence=1

ELSE:

The mission priorities are: - Confidence=1

RULE NUMBER: 15 (MR--5)
IF:

The mission cancellation delay times tolerances have: not been established

THEN:

Get user to determine mission delay time tolerances - Confidence=1

ELSE:

The tolerances for mission delay time are: - Confidence=1

RULE NUMBER: 16 (MR--6)
IF:

The mission tasks for the system (based on need) have: not been determined

THEN:

Coordinate with user to formulate tasks and/or study measures for alternatives being examined - Confidence=1

ELSE:

The mission tasks for the system are: - Confidence=1

RULE NUMBER: 17 (O&S--2)
IF:

The aircraft sortie rates have not been determined

THEN:

Get aircraft sortie rates from user - Confidence=1

ELSE:

The aircraft sortie rates are: - Confidence=1

RULE NUMBER: 18 (O&S--3)
IF:
The requirements for complementary missions have: not been determined

THEN:
Get user to determine requirements for complementary missions - Confidence=1

ELSE:
The requirements for complementary missions are: - Confidence=1

RULE NUMBER: 19 (O&S--4)
IF:
The interfaces with other systems (for example: support aircraft or resources for particular missions) have: not been considered

THEN:
Review the lack of interface data with user - Confidence=1

RULE NUMBER: 20 (O&S--5)
IF:
The interfaces with other systems (for example: support aircraft or resources for particular missions) have: been considered

and The appropriate interface data is: available

THEN:
The interfaces with other systems and their data are: - Confidence=1

RULE NUMBER: 21
IF:
The interfaces with other systems (for example: support aircraft or resources for particular missions) have: been considered

and The appropriate interface data is: not available

THEN:
Get data for interface systems from user - Confidence=1

RULE NUMBER: 22 (GA--2)
IF:
The number of aircraft on alert at each location is: not available

THEN:
Get number of aircraft on alert at each location from user - Confidence=1

ELSE:
The number of aircraft on alert at each location is: - Confidence=1

RULE NUMBER: 23 (GA--3)
IF:
The missions to be flown from alert have: not been determined

THEN:
Get missions to be flown from alert information from user - Confidence=1

ELSE:
Missions to be flown from alert are: - Confidence=1

RULE NUMBER: 24 (GA--4)
IF:
The frequency of alert missions has: not been determined

THEN:
Get frequency of alert missions information from user - Confidence=1

ELSE:
The frequency of alert missions is: - Confidence=1

RULE NUMBER: 25 (GA--5)
IF:
The alert replacement policies (for example, replacement when launched or same aircraft return from alert) have not been determined

THEN
Get alert replacement policy information from user - Confidence=1

ELSE
The alert replacement policy is - Confidence=1

RULE NUMBER: 26 (MC&O--2)

IF:

The maintenance concept (for example: 2 level--remove and replace; 3 level--repair and replace) have: not been determined

THEN:

Get user to determine maintenance concept to be used - Confidence=1

ELSE:

The maintenance concept to be used is: - Confidence=1

RULE NUMBER: 27 (MC&O--3)

IF:

The organizational structure and maintenance concept level: does not match

THEN:

Get with user to rectify organization structure and maintenance concept level - Confidence=1

ELSE:

The organization structure is: - Confidence=1

RULE NUMBER: 28 (MC&O--4)

IF:

The AFSC structure and organizational structure are: not in compliance

THEN:

Get with user to rectify differences in AFSC structure, organization structure, and maintenance concept level- Confidence=1

ELSE:

The AFSC structure is: - Confidence=1

RULE NUMBER: 29 (MC&O--5)

IF:

The AFSC structure and maintenance concept level specifications are: not in compliance

THEN:

Get with user to rectify differences in AFSC structure, organization structure, and maintenance concept level - Confidence=1

ELSE:

The AFSC structure is: - Confidence=1

RULE NUMBER: 30 (GENERAL RMTS--1)
IF:
The scenario is a __ format: NOT other
and The scenario/IOC year consistency is: Yes
and The Engineering Change Proposal is: available

THEN:
General Requirements - Confidence=1

ELSE:
General Requirements - Confidence=0

RULE NUMBER: 31 (F&D--1)
IF:
The number of locations and number of aircraft at each site have: been determined

and The supply concept (for example:deploy with War Readiness Spares Kit for xxx days) has: been determined

and The resupply time has: been determined

and The extent of maintenance capability required at each site has: been determined

and The shelters at each site has: been determined

and The facilities and support equipment for each site have: been determined

THEN:
Facilities and Deployment - Confidence=1

ELSE:
Facilities and Deployment - Confidence=0

RULE NUMBER: 32 (GA--1)
IF:
The number of aircraft on alert at each location is: available

and The missions to be flown from alert have: been determined

and The frequency of alert missions has: been determined

and The alert replacement policies (for example, replacement when launched or same aircraft return from alert) have: been determined

THEN:

Ground Alert - Confidence=1

ELSE:

Ground Alert - Confidence=0

RULE NUMBER: 33 (MC&O--1)

IF:

The maintenance concept (for example: 2 level--remove and replace; 3 level--repair and replace) have: been determined

and The organizational structure and maintenance concept level: matches

and The AFSC structure and organizational structure are: in compliance

and The AFSC structure and maintenance concept level specifications are: in compliance

THEN:

Maintenance Concepts and Organization - Confidence=1

ELSE:

Maintenance Concepts and Organization - Confidence=0

RULE NUMBER: 34 (MR--1)

IF:

The mission types (for example: Interdiction; Combat Air Patrol) have: been determined

and The aircraft configuration for each mission has: been determined

and The mission priorities have: been determined

and The mission cancellation delay times tolerances have: been established

and The mission tasks for the system (based on need) have: been determined

THEN:

Mission Requirements - Confidence=1

ELSE:

Mission Requirements - Confidence=0

RULE NUMBER: 35 (O&S—1)

IF:

The aircraft sortie rates have been determined

and The requirements for complementary missions have: been determined

and The interfaces with other systems (for example: support aircraft or resources for particular missions) have: been considered

and The appropriate interface data is: available

THEN:

Operations and Scheduling Policy - Confidence=1

ELSE:

Operations and Scheduling Policy - Confidence=0

RULE NUMBER: 36

IF:

General Requirements- Conf. = 1
and Facilities and Deployment- Conf. = 1
and Mission Requirements- Conf. = 1
and Operations and Scheduling Policy- Conf. = 1
and Ground Alert- Conf. = 1
and Maintenance Concepts and Organization- Conf. = 1

THEN:

Proceed to disseminate information for COEA Request to LCOM and TAC THUNDER. - Confidence=1

ELSE:

Not all information is available for LCOM and TAC THUNDER to process this COEA - Confidence=1

Appendix F: User Interface Messages

I. LCOM

Starting text:

Welcome to the Cost and Operational Effectiveness Analysis (COEA) Information Gathering Process Expert System for the Logistics Composite Model (LCOM). If at anytime you do not understand what any of the questions are asking for, please consult the accompanying documentation or as a last resort the COEA expert within the LCOM area. If there are questions that are not covered by any of the above sources, please consult with the expert system designers Constance S. Maginnis or Michael J. Monroe at 255-8989.

Ending text:

Thank you for using the LCOM COEA Information Gathering Process Expert System. The next screen will display the results of the current Data Run. Each area of query answered and the confidence level is listed separately in order of the questions asked. You may change any of the initial parameters by clicking on the <Change/Rerun> button and modifying the parameter(s) desired. The latest Data Run will appear in the first column and the initial Data Run will appear in the second column. You can easily compare the impact of one alteration of the input parameters.

II. TAC THUNDER

Starting text:

Welcome to the Cost and Operational Effectiveness Analysis (COEA) Information Gathering Process Expert System for the TAC THUNDER model. If at anytime you do not understand what any of the questions are asking for, please consult the accompanying documentation or as a last resort the COEA expert within the TAC THUNDER area. If there are questions that are not covered by any of the above sources, please consult with the expert system designers Constance S. Maginnis or Michael J. Monroe at 255-8989.

Ending text:

Thank you for using the TAC THUNDER COEA Information Gathering Process Expert System. The next screen will display the results of the current Data Run. Each area of query answered and the confidence level is listed separately

in order of the questions asked. You may change any of the initial parameters by clicking on the <Change/Rerun> button and modifying the parameter(s) desired. The latest Data Run will appear in the first column and the initial Data Run will appear in the second column. You can easily compare the impact of one alteration of the input parameters.

III. COEA Gatherer

S'arting Text:

Welcome to the Cost and Operational Effectiveness Analysis (COEA) Information Gathering Process Expert System. If at anytime you do not understand what any of the questions are asking for, please consult the accompanying documentation or as a last resort the COEA expert within the Gatherer area. If there are questions that are not covered by any of the above sources, please consult with the expert system designers Constance S. Maginnis or Michael J. Monroe at 255-8989.

Ending Text:

Thank you for using the COEA Gatherer. The next screen will display the results of the current Data Run. Each area of query answered and the confidence level is listed separately in order of the questions asked. There are several different files that can be saved and printed for the user's convenience. Please see the accompanying documentation for full details.

Appendix G: Knowledge Base

I. LCOM

QUALIFIERS:

1 the Engineering Change Proposal provided with the COEA is

available
not available

2 the Logistics Support Analysis aircraft data is

available
not available

3 other Air Force maintenance data is

available
not available

4 a historical Air Force Maintenance Database (DB) is

available
not available

5 other Non-AF DB are

available
not available

6 the sequence of maintenance tasks to be performed is

available
not available

7 the resource requirements for each specific maintenance task are

available
not available

8 the task time for each maintenance task to be performed is

available
not available

9 the specifications for each maintenance crew required to perform each maintenance task are

available
not available

10 the support facilities required for each maintenance task to be performed are

available
not available

11 the reliability values required for each maintenance task to be performed are

available
not available

12 the specific LCOM DB scenario is

available in-house
not available in-house

13 the flying schedule within the DB is

the same
different

14 the mission types within the scenario to be used are

the same
different

15 the DB to be used has

been run within the LCOM simulation model
not been run within the LCOM simulation model

16 the DB has been run within the LCOM simulation model, and the results are

good
bad

CHOICES:

1 Proceed with the COEA Information Gathering Process. ECP availability is at

2 Check the validity of the Proposed COEA with the Systems Program Office and , if necessary, consult with the COEA expert. ECP nonavailability is at

3 Proceed with the COEA Information Gathering Process. The necessary Analysis Data availability is at

4 Check the validity of the COEA Proposal with the Systems Program Office and the COEA expert since there is no Analysis Data available at

5 Continue the COEA Information Gathering Process. The Specific Task Data availability is at

6 Look for comparable data that matches the Specified Task Data or ask the COEA expert for guidance in finding data for that specific task area. The nonavailability of the Specific Task Data is at

7 Proceed with the COEA Information Gathering Process. The Scenario availability is at

8 Check other sources with the same type of aircraft as indicated in the COEA Proposal (like MAJCOMs, other services, or commercial aviation services) to get the needed Scenario specific data. The need for Scenario specific data is at

9 Ensure the validity of the proposed COEA with the Systems Program Office and the COEA expert. The nonavailability of the specific Scenario is at

10 Continue with the COEA Information Gathering Process. The availability of the DB is at

11 Modify the scenario to fit the required parameters. The need to modify the DB is at

12 Proceed with the COEA Information Gathering Process. The DB Integrity Check is at

13 The COEA Information Gathering Process is now complete. Inform the COEA expert that all the required information is now in-hand and that the COEA Proposal is ready to be run.

14 Run the DB through the LCOM simulation model. The need for a DB Integrity Check is at

15 Investigate the errors specified from the DB Integrity Check by the LCOM simulation model. Determine the magnitude of the corrections necessary. The need to bring the DB up to the necessary integrity is at

<u>II. TAC THUNDER COEA KBS</u>

QUALIFIERS:

1 the scenario year is

consistent
inconsistent

2 several years have

been identified
not been identified

3 the scenarios are

traceable back to DPG/IPS
not traceable back to DPG/IPS

4 the scenarios seem

appropriate
contrived

5 the scenarios have

identified the mission tasking for the alternatives
not identified the mission tasking for the alternatives

6 at least one of the scenarios provide(s) a(n)

unlikely
stressful and likely cases

7 the scenarios present a(n)

good operational range of possibilities
unacceptable range of possibilities

8 the number of theaters selected is

one
more than one

9 the DPG/IPS scenarios are built on a

validated threat
nonvalidated threat

10 blue systems aircraft and ground assets are

correctly modeled
incorrectly modeled

11 the user/sponsor has

reviewed the proposed scenario database
not reviewed the proposed scenario database

12 the mission tasks for the system have

not been identified based on need
been identified based on need

13 the mission tasks are

quantified
not quantified

14 the employment of the system is

feasible
not feasible

15 the operations and maintenance force structure is

valid
not valid

16 the interfaces with other systems have

been considered
not been considered

17 each alternative has

been described in detail
not been described in detail

18 the current system baseline has

been identified
not been identified

19 the adequate range of alternatives has

been identified
not been identified

20 the alternatives do

consider changes in the requirements
not consider changes in the requirements

21 the current or prospective systems contain

reasonable alternatives
unreasonable alternatives

22 the rationale for the non-selection for alternatives has

been explained
not been explained

CHOICES:

1 Proceed with COEA Information Gathering Process. The year of study consistency is at

2 Review the consistency of the study year with the study leader. Study year inconsistency is at

3 Proceed with COEA Information Gathering Process. The availability of the necessary number of study years is at

4 Ask study leader if single year analysis is acceptable. Availability of only a single study year is at

5 Proceed with COEA Information Gathering Process. The traceability of the scenarios is at

6 Provide rationale from user/sponsor for use of non-DPG/IPS scenarios. Use of non-DPG/IPS scenarios is at

7 Proceed with COEA Information Gathering Process. The appropriateness of the scenarios used is at

8 Review scenario problems with study leader. Document/provide rationale for questionable areas and get study leader approval to continue process.

9 Proceed with COEA Information Gathering Process. The likelihood that the scenarios do identify tasking alternatives is at

10 Get a complete listing of mission taskings from the user/sponsor. The need for this listing is at

11 Proceed with COEA Information Gathering Process. The likelihood that the scenarios provide all cases is at

12 Review scenario cases with the study leader. The likelihood of a problem with one or more of the scenarios is at

13 Proceed with COEA Information Gathering Process. The proposed scenarios do present a good range of possibilities is at

14 Consider adding additional scenario(s) to get a good operational range.

15 Proceed with COEA Information Gathering Process. Theater selection is at

16 Get/provide rationale from the user/sponsor for a one theater option. If no rationale forthcoming, get study leader approval before continuing process.

17 Proceed with COEA Information Gathering Process. Good threat assessment is at

18 Obtain STAR (System Threat Assessment Report) from FASTC. The need for this information is at

19 Proceed with COEA Information Gathering Process. The correct representation of the blue forces is at

20 Contact mission level office for a review of blue system assets.

21 Proceed with COEA Information Gathering Process. The need for user/sponsor review of the proposed scenario is at

22 Get approval/coordination from study leader and user/sponsor. Incorporate any changes noted.

23 Proceed with COEA Information Gathering Process. The identification of mission tasks based upon need is at

24 Coordinate with study leader to formulate appropriate tasks and/or study measures for the alternatives being examined.

25 Proceed with COEA Information Gathering Process. The quantification of mission tasks is at

26 Develop quantifiable mission objectives/tasks.

27 Proceed with COEA Information Gathering Process. The feasibility of the employment portion of the study is at

28 Review employment concept with user/sponsor.

29 Proceed with COEA Information Gathering Process. The validity of the overall force structure is at

30 Review force structure with user/sponsor.

31 Proceed with COEA Information Gathering Process. The consideration of other interfaces is at

32 Review the lack of system interface data with user/sponsor.

33 Proceed with COEA Information Gathering Process. The appropriate interface data availability is at

34 Obtain interface data from user/sponsor.

35 Proceed with COEA Information Gathering Process. Each alternative's description is at

36 Obtain necessary description details from user/sponsor.

37 Proceed with COEA Information Gathering Process. The baseline case identification is at

38 Review baseline case with user/sponsor.

39 Proceed with COEA Information Gathering Process. The availability of an adequate range is at

40 Review proposed range with study leader and user/sponsor. Provide rationale for proposed range.

41 Proceed with COEA Information Gathering Process. The adequacy of the changes considered is at

42 Review with study leader and user/sponsor. Provide rationale for this consideration of requirements.

43 Proceed with COEA Information Gathering Process. The reasonableness of the alternatives is at

44 Review with study leader and user/sponsor. Document rationale for using specified alternatives.

45 Proceed with COEA Information Gathering Process. Non-selection rationale availability is at

46 Document rationale for non-selection of alternatives.

III. Gatherer

QUALIFIERS:

1 The scenario is a __ format:

Peacetime
Wartime
other

Name: GENERAL RQMTS--1
Maximum acceptable = 1

2 The scenario/IOC year consistency is:

Yes
No

Name: GENERAL RQMTS--2
Maximum acceptable = 1

3 The Engineering Change Proposal is:

available
not available

Name: GENERAL RQMTS--3
Maximum acceptable = 1

4 The number of locations and number of aircraft at each site have:

been determined
not been determined

Name: F & D--1
Maximum acceptable = 1

5 The supply concept (for example:deploy with War Readiness Spares Kit for xxx days) has:

been determined
not been determined

Name: F & D--2
Maximum acceptable = 1

6 The resupply time has:

been determined
not been determined

Name: F & D--3
Maximum acceptable = 1

7 The extent of maintenance capability required at each site has:

been determined
not been determined

Name: F & D--4
Maximum acceptable = 1

8 The shelters at each site has:

been determined
not been determined

Name: F & D--5
Maximum acceptable = 1

9 The facilities and support equipment for each site have:

been determined
not been determined

Name: F & D--6
Maximum acceptable = 1

10 The mission types (for example: Interdiction; Combat Air Patrol) have:

been determined
not been determined

Name: MR--1
Maximum acceptable = 1

11 The aircraft configuration for each mission has:

been determined
not been determined

Name: MR--2
Maximum acceptable = 1

12 The mission priorities have:

been determined
not been determined

Name: MR--3
Maximum acceptable = 1

13 The mission cancellation delay times tolerances have:

been established
not been established

Name: MR--4
Maximum acceptable = 1

14 The mission tasks for the system (based on need) have:

been determined
not been determined

Name: MR--5
Maximum acceptable = 1

15 The aircraft sortie rates have

been determined
not been determined

Name: O&SP--1
Maximum acceptable = 1

16 The requirements for complementary missions have:

been determined
not been determined

Name: O&SP--2
Maximum acceptable = 1

17 The interfaces with other systems (for example: support aircraft or resources for particular missions) have:

been considered
not been considered

Name: O&SP--3
Maximum acceptable = 1

18 The appropriate interface data is:

available
not available

Name: O&SP--4
Maximum acceptable = 1

19 The number of aircraft on alert at each location is:

available
not available

Name: GA--1
Maximum acceptable = 1

20 The missions to be flown from alert have:

been determined
not been determined

Name: GA--2
Maximum acceptable = 1

21 The frequency of alert missions has:

been determined
not been determined

Name: GA--3
Maximum acceptable = 1

22 The alert replacement policies (for example, replacement when launched or same aircraft return from alert) have:

been determined
not been determined

Name: GA--4
Maximum acceptable = 1

23 The maintenance concept (for example: 2 level--remove and replace; 3 level--repair and replace) have:

been determined
not been determined

Name: MC&O--1
Maximum acceptable = 1

24 The organizational structure and maintenance concept level:

matches
does not match

Name: MC&O--2
Maximum acceptable = 1

25 The AFSC structure and organizational structure are:

in compliance
not in compliance

Name: MC&O--3
Maximum acceptable = 1

26 The AFSC structure and maintenance concept level specifications are:

in compliance
not in compliance

Name: MC&O--4
Maximum acceptable = 1

CHOICES:

1 Proceed to disseminate information for COEA Request to LCOM and TAC THUNDER.

2 Not all information is available for LCOM and TAC THUNDER to process this COEA

3 General Requirements

4 Facilities and Deployment

5 Mission Requirements

6 Operations and Scheduling Policy

7 Ground Alert

8 Maintenance Concepts and Organization

9 Scenario is Peacetime

10 Scenario is Wartime

11 LCOM and TAC THUNDER are not designed for scenarios other than Peacetime or Wartime

12 See COEA focal point for further guidance

13 Review scenario/IOC year with user to resolve and/or verify discrepancy

14 The scenario/IOC year is:

15 Check validity of Engineering Change Proposal with user

16 The Engineering Change Proposal information is:

17 Get the numbers and locations of aircraft at each site from users

18 The numbers and locations of aircraft at each site are:

19 Get the supply concept information from user

20 The supply concept is:

21 Get the resupply time information from user

22 The resupply time is:

23 Get the extent of maintenance capability required at each site from user

24 The maintenance capability required at each site is:

25 Get the shelter information for each site from user

26 The shelter information at each site is:

27 Get the facilities and support equipment requirements for each site from user

28 The facilities and support equipment requirements for each site are:

29 Get the mission types from user

30 The mission types are:

31 Get the aircraft configuration for each mission from user

32 The aircraft configuration for each mission is:

33 Get the user to establish mission priorities

34 The mission priorities are:

35 Get user to determine mission delay time tolerances

36 The tolerances for mission delay time are:

37 Coordinate with user to formulate tasks and/or study measures for alternatives being examined
38 The mission tasks for the system are:

39 Get aircraft sortie rates from user

40 The aircraft sortie rates are:

41 Get user to determine requirements for complementary missions

42 The requirements for complementary missions are:

43 Review the lack of interface data with user

44 The interfaces with other systems and their data are:

45 Get data for interface systems from user

46 Get number of aircraft on alert at each location from user

47 The number of aircraft on alert at each location is:

48 Get missions to be flown from alert information from user

49 Missions to be flown from alert are:

50 Get frequency of alert missions information from user
51 The frequency of alert missions is:

52 Get alert replacement policy information from user

53 The alert replacement policy is:

54 Get user to determine maintenance concept to be used

55 The maintenance concept to be used is:

56 Get with user to rectify organization structure and maintenance concept level

57 The organization structure is:

58 Get with user to rectify differences in AFSC structure, organization structure, and maintenance concept level

59 The AFSC structure is:

Appendix H: COEA Usage Within the Acquisition Lifecycle

The DoD Acquisition Management System has five phases: I. Concept Exploration Definition, II. Demonstration and Validation, III. Engineering Manufacturing Development, IV. Production and Deployment, and V. Operations and Support (O&S).

The COEA is an essential part of the DoD acquisition system. COEAs are required for DoD Acquisition Category (ACAT) I programs, and may be required for ACAT II, III, and IV programs.

COEAs

Pre-Milestone 0: Determination of Mission Need

The COEA process should begin as early as possible. While there is no specific requirement for COEA activities prior to milestone 0, the analysis performed to identify needs will compare the threat, current capabilities, and technology opportunities to determine whether or not a new development effort is indicated.

Phase I: Concept Exploration and Definition

Government and contractor phase I studies define and assess the feasibility and rough lifecycle cost estimates of alternative concepts for satisfying the identified need. These results are used in the Phase I COEA to analyze cost, schedule, and performance tradeoffs of the alternatives. The phase I COEA: (1) identifies the advantages and disadvantages of acquiring a new system over modifying the existing one, (2) defines the characteristics needed in the new system (i.e., performance and cost goals for the next phase), and (3) screens the number of alternatives to be considered in later phases.

Phase II: Demonstration and Validation

The Phase II COEA will include cost, performance, supportability, and schedule trade-offs of the alternative concepts. Cost drivers should be identified, along with maximum cost and minimum performance levels. This COEA will be more detailed than the Phase I COEA. There should be fewer and more clearly defined alternatives. In extreme cases, concepts discarded at milestone I may be reconsidered during Phase II.

Phase III: Engineering and Manufacturing Development

The Phase III COEA may be only an update of the Phase II COEA. However, if major cost or performance changes have occurred during phase II, a new COEA may be required. The decision authority will specify the elements of the analysis that require updating.

Phase IV: Production and Deployment

If a major revision may be necessary, the decision authority may require a Phase IV COEA. The elements of this analysis will be specified as part of the planning process.

Appendix I: Report Results -- COEA Gatherer

I. Input Data From Validation Test

The scenario is a __ format: Wartime

The scenario/IOC year consistency is: Yes

The Engineering Change Proposal is: not available

The number of locations and number of aircraft at each site have: not been determined

The supply concept (for example:deploy with War Readiness Spares Kit for xxx days) has: not been determined

The resupply time has: not been determined

The extent of maintenance capability required at each site has: not been determined

The shelters at each site has: not been determined

The facilities and support equipment for each site have: not been determined

The mission types (for example: Interdiction; Combat Air Patrol) have: been determined

The aircraft configuration for each mission has: been determined

The mission priorities have: been determined

The mission cancellation delay times tolerances have: been established

The mission tasks for the system (based on need) have: been determined

The aircraft sortie rates have: been determined

The requirements for complementary missions have: been determined

The interfaces with other systems (for example: support aircraft or resources for particular missions) have: been considered

The appropriate interface data is: available

The number of aircraft on alert at each location is: available

The missions to be flown from alert have: not been determined

The frequency of alert missions has: not been determined

The alert replacement policies (for example, replacement when launched or same aircraft return from alert) have: been determined

The maintenance concept (for example: 2 level--remove and replace; 3 level--repair and replace) have: not been determined

The organizational structure and maintenance concept level: matches

The AFSC structure and organizational structure are: in compliance

The AFSC structure and maintenance concept level specifications are: in compliance

II. Results as Displayed by COEA Gatherer

The following is available for LCOM to process this COEA:

Scenario is Wartime

The mission types are:

The aircraft configuration for each mission is:

The mission priorities are:

The tolerances for mission delay time are:

The aircraft sortie rates are:

The requirements for complementary missions are:

The number of aircraft on alert at each location is:

The alert replacement policy is:

The organization structure is:

The AFSC structure is:

The following still needs to be obtained for LCOM or issues resolved:

Check validity of Engineering Change Proposal with user

Get the numbers and locations of aircraft at each site from users

Get the supply concept information from user

Get the resupply time information from user

Get the extent of maintenance capability required at each site from user

Get the shelter information for each site from user

Get the facilities and support equipment requirements for each site from user

Get missions to be flown from alert information from user

Get frequency of alert missions information from user

Get user to determine maintenance concept to be used

The following information is available for TAC THUNDER to process this COEA:

Scenario is Wartime

The scenario/IOC year is:

The mission types are:

The aircraft configuration for each mission is:

The mission priorities are:

The mission tasks for the system are:

The aircraft sortie rates are:

The requirements for complementary missions are:

The interfaces with other systems and their data are:

The number of aircraft on alert at each location is:

The alert replacement policy is:

The following information still needs to be obtained or problems resolved for TAC THUNDER:

Get the numbers and locations of aircraft at each site from users

Get the supply concept information from user

Get the shelter information for each site from user

Get missions to be flown from alert information from user

Get frequency of alert missions information from user

Get user to determine maintenance concept to be used

Bibliography

Boyd, C‹ Stanley E. Deputy Chief of Staff, Development Pl‹ Aeronautical Systems Center, Wright-Patterson AF‹ Official Letter. 29 April 1992.

Corpora‹rmation Management Process Improvement Me‹gy for DOD Functional Managers. D. Appleton Co‹ Inc., Fairfax VA, 1993.

Cronk, ‹. Group Leader, Logistics Composite Model, Ae‹ical Systems Center, Wright-Patterson AFB OH. Pe‹ Interviews. October 1992 through August 1993.

Davis, ‹ "Operational Prototyping: A New Development Ap‹" IEEE Software, 70-78 (September 1992).

Departm‹ the Air Force. Cost and Operational Ef‹ness Analysis. AFSCP 173-1. Wright-Patterson AF‹ 15 November 1990.

EXSYS P‹onal Expert System Development Software Manual EX‹buquerque NM 1991.

Griffin,‹M. Director, Development Planning, Ae‹ical Systems Center, Wright-Patterson AFB OH. Of‹ Letter. 23 December 1992.

Hayes-R‹ederick, Donald A. Waterman, and Douglas B. Le‹ilding Expert Systems. Reading MA: Addison-We‹blishing Company, Inc., 1983.

Horngre‹rles T. and George Foster. Cost Accounting. En‹ Cliffs NJ: Prentice Hall, 1991.

Irwin, ‹.C. An Expert System For Measuring, Int‹ing, and Managing System Performance Factors fo‹ork Information Management System. MS thesis, AF‹LSM/91D-5. School of Systems and Logistics, Ai‹ Institute of Technology (AU), Wright-Pat‹ AFB OH, December 1991 (AD-A246878).

Kamel, ‹. and Moshe Zviran. "A Methodology for Int‹ng Heterogeneous Data Bases in a Hospital En‹nt," Journal of Systems Software, 15:251-260 (1‹

Mockler,‹t J. and D.G. Dologite. An Introduction to Ex‹stems. New York: Macmillan Publishing Company, 19‹

Nelson, Richard G. An Application of Artificial Intelligence Technology Within the Standard Base Supply System. MS thesis, AFIT/GLM/LSM/91S-49. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, September 1991 (AD-A246873).

Swindoll, Charles R. and Lee Hough. Improving Your Serve: The Art of Unselfish Living (Fifth Edition). Anaheim CA: Insight For Living, 1993.

Turban, Efraim. Decision Support and Expert Systems: Management Support Systems (Second Edition). New York: Macmillan Publishing Company, 1990.

Walker, Warren E. "Differences Between Building a Traditional DSS and an ODSS: Lessons From the Air Force's Enlisted Force Management System," IEEE, 120-127 (1990).

Waterman, Donald A. A Guide to Expert Systems. Reading MA: Addison-Wesley Publishing Company, Inc., 1986.

Wyse, James E. and Christopher A. Higgins. "MIS Integration: A Framework For Management," Journal of Systems Management, 32-37 (February 1993).

Vita

Constance S. Maginnis was born on 14 July 1951 in Oxford, Nebraska. She graduated from Cambridge High School in Cambridge, Nebraska in 1969. The next four years she attended Kearney State College in Kearney, Nebraska, graduating with a Bachelor of Science in Education (specialty: Secondary Mathematics) in May 1973. Her civil service career began in January 1980 at Hill AFB, Utah. She began as a GS-7 mathematician working on the shred-out and reformatting of F4 flight-test data. She has also served in numerous other positions including operations research analyst, systems programmer, and supervisory programmer analyst. In 1984 she completed the associate program of the Air Command and Staff College. Upon her completion of the graduate program in December 1993 at the School of Logistics and Acquisitions Management, Air Force Institute of Technology she will return to her current position as a GS-13 computer scientist on the Computer Performance and Evaluation Team in the 649th Communications-Computer Group at Hill AFB, Utah.

Permanent Address: 1280 Valhalla Dr.
Clearfield, UT
84015

Vita

Michael J. Monroe was born on 11 Oct 1956 in West Palm Beach, Florida. He graduated from Sumter High School in Sumter, South Carolina in 1974. The next four years he attended the University of South Carolina in Columbia, SC, graduating with a Bachelor of Arts in Journalism in May 1978. He joined the Air Force in 1982 as an Enlisted MAJCOM Programming Specialist and went to Officers Training School in 1984. After four years in Intercontinental Ballistic Missiles, Captain Monroe cross-trained into the 70XX career field. After completing his Master of Arts in Political Science in May 1988, he went to Squadron Officers School in residence in May 1989. Upon his completion of the graduate program in December 1993 at the School of Logistics and Acquisition Management, Air Force Institute of Technology, Captain Monroe will be assigned to the Future Plans Branch at Headquarters Air Education and Training Command, Randolph AFB, Texas.

Permanent Address: 1409 Spears Creek Road
Lugoff, SC 29078

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	December 1993	Master's Thesis

4. TITLE AND SUBTITLE

INFORMATION SHARING WITHIN THE COEA PROCESS

5. FUNDING NUMBERS

6. AUTHOR(S)

Constance S. Maginnis, GS-13, USAF
Michael J. Monroe, Captain, USAF

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Air Force Institute of Technology,
Wright-Patterson AFB OH 45433-6583

8. PERFORMING ORGANIZATION REPORT NUMBER

AFIT/GIR/LAR/93D-9

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

ASC/XRECR
Bldg 125 Room 1308
WPAFB, OH
45433

ASC/XRECT
Bldg 11A Room 001
WPAFB, OH
45433

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release;
distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

In order to meet the challenges of a reduced work force and the changing roles and/or missions of the Air Force in particular, the Cost and Operational Effectiveness Analysis (COEA) is used in the decision-making of every phase of the acquisition process. The Office of the Assistant Secretary of Defense (OASD) has mandated that COEAs are to be an integral part of the acquisition process.

The COEA information gathering or sharing process is not well defined. Areas within the COEA process affected are the coordination of common elements of information required, the data collection, and the generation of possible solutions. The problem addressed by this research is how to improve the COEA information sharing process for data used to produce analyses for an organization. This improved process should result in a reduction of the time spent in continual meetings and conferences resolving conflicts within the process areas.

The result of our research indicates that the different processes within the COEA information process could be organized within a knowledge-based system (KBS) for improving the sharing of information and the overall efficiency of the process.

14. SUBJECT TERMS

Cost Operational Effectiveness Analysis, COEA,
Knowledge-based systems, KBS, Information Sharing

15. NUMBER OF PAGES

129

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

AFIT Control Number AFIT/GIR/LAR/93D-9

AFIT RESEARCH ASSESSMENT

The purpose of this questionnaire is to determine the potential for current and future applications of AFIT thesis research. Please return completed questionnaires to: DEPARTMENT OF THE AIR FORCE, AIR FORCE INSTITUTE OF TECHNOLOGY/LAC, 2950 P STREET, WRIGHT PATTERSON AFB OH 45433-7765

1. Did this research contribute to a current research project?

a. Yes b. No

2. Do you believe this research topic is significant enough that it would have been researched (or contracted) by your organization or another agency if AFIT had not researched it?

a. Yes b. No

3. The benefits of AFIT research can often be expressed by the equivalent value that your agency received by virtue of AFIT performing the research. Please estimate what this research would have cost in terms of manpower and/or dollars if it had been accomplished under contract or if it had been done in-house.

Man Years ______________ $ ______________

4. Often it is not possible to attach equivalent dollar values to research, although the results of the research may, in fact, be important. Whether or not you were able to establish an equivalent value for this research (3, above) what is your estimate of its significance?

a. Highly Significant b. Significant c. Slightly Significant d. Of No Significance

5. Comments

______________________________ ______________________________

Name and Grade Organization

______________________________ ______________________________

Position or Title Address